The FOUNDRY

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Castings Help Electricity Drive Away Darkness

MAN gradually has developed sources of illumination which rival the sun in brilliancy. The activities of the human race, in that period between the dusk and dawn, have increased remarkably since electricity and gas have been applied to the solution of lighting problems. Since ancient times, the manufacture of the various types of lighting equipment has offered an opportunity for the skilled artisan. Although the sources of light utilized by the ancient Egyptians, Chinese, Japanese, and Greeks were exceptionally crude, the fixtures employed in many cases were elaborate. The open flame oil and grease lamps of that period before the Christian era were cast of metals. The holders for candles used in the middle ages were made of many cast parts. The modern electric and gas lighting fixtures of the twentieth century in many instances are constructed entirely of metals which are molded and cast. Lighting fixtures in the home, the office, the factory, the store, theatre, and hundreds of other places where darkness vanishes at man's command present possibilities for the nonferrous and the gray iron foundry. The value of gas and electric fixtures manufactured in 1923, according to the department of commerce, was $47,412,578 as compared with $25,689,892 in 1921.

Beautiful Fixtures in Public Buildings Are Made of Cast Parts

Find Where Castings Can Be Sold

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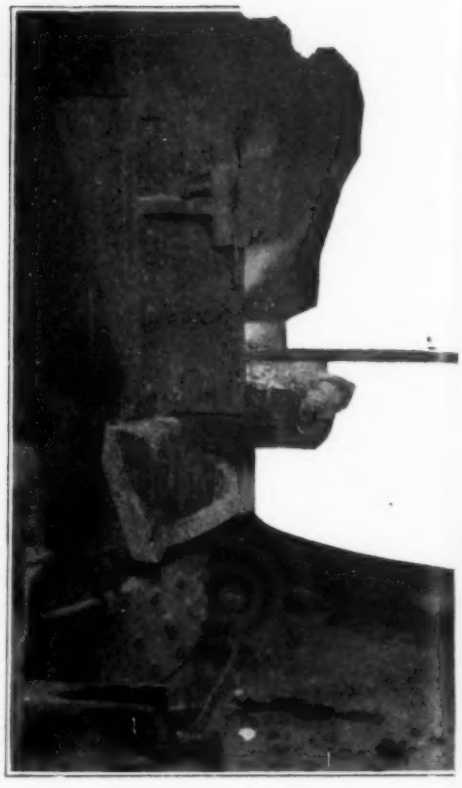
Apprentices Want To Know



Call It Natural Curiosity or Scientific Interest, the Boy Has an Inquiring Turn of Mind

"IT IS no longer necessary to argue apprenticeship as such. American manufacturers as a whole have become convinced fully during the last few years that apprenticeship, the training of boys for industry by organized programs of work, is absolutely essential. It remains now to demonstrate how apprenticeship can be made practical, how it can actually be established in American manufacturing plants." Thus spoke the educational director of one of the largest and must prominent associations of manufacturers a few weeks ago. Apparently, it may be taken for granted, that the manufacturer believes in apprenticeship. Apprenticeship would be established universally if it were not for the difficulty of getting the work actually organized in the shop, and when the difficulties of organizing apprenticeship have been analyzed it will be seen that most of them center about the problem of getting boys.

The foundryman is handicapped more seriously in attracting boys to apprenticeship than anyone else. Many foundries have undertaken the training of apprentices. A few have succeeded, most of them have failed and, considering their methods, it is no wonder that they have failed. Usually, the board of directors, the manager or the superintendent has decided to engage apprentices, under pressure of complaints from all sides concerning the scarcity of good foundrymen and the advancing age of those that are available. Thereupon word is passed along that apprenticeship is to be established in the plant.

Investigation of Heat Treating Problems Serves To Spur the Ambitions of Those Studying Foundry Methods

Usually, the assistant superintendent or general foreman or some other official is notified that he is to take charge of the boys and see that they are taught the trade. The man chosen may not be the one best qualified for the work or most willing to do it, but the one whose duties most easily permit him to take on this responsibility. He is given no further instructions on the work the boys are to perform.

The bewildered employment manager, whose traditional attitude toward extremely young men is anything but favorable, is told to get a few boys into the shop to become apprentices. Nothing is said regarding the qualifications of these boys and the first three or four who come along are sent into the shop and put to work.

In rare instances the man placed in charge of the apprentices or someone else in the shop just happens to be interested in boys and by his constant attention and encouragement gradually makes a success of the enterprise in spite of the careless manner in which it is organized. More frequently the boys begin work in the foundry at odd jobs. The man in charge of them cannot spare the time from his regular work and so

What Goes on Inside the Works

By C. J. Freund

neglects them. Higher officials cannot bother to devote time to such a detailed matter as apprenticeship and assume that the shopmen are taking care of it. In a few months or weeks, the boys have drifted into the status of common laborers and the reason for their presence in the plant gradually is forgotten. One by one they leave. Other boys are hired because the big boss wants apprentices in the shop and they too leave under similar circumstances. These boys warn their friends and the reputation of the shop soon is established among the young men in the community and the employment manager is unable to engage additional boys. Thereupon, it is decided that the modern American young men is lazy and good for nothing, that he is a *sissy* and afraid to work and that apprenticeship under present industrial conditions cannot be established.

It is any wonder that apprenticeship fails under these conditions which, unfortunately, are only too typical?

While no attempt may be made to exploit the boys and the management may have the best of intentions the movement is not taken seriously. The cardinal principle of success in apprentice work is that apprenticeship is a most important function of shop management. It is not a side issue. Apprenticeship must be studied thoroughly both in relation to the work of the trade and to the nature of the boy and definite plans must be made. Thereupon, the apprenticeship idea must be propagated in the community by a definite, thorough and enthusiastic campaign.

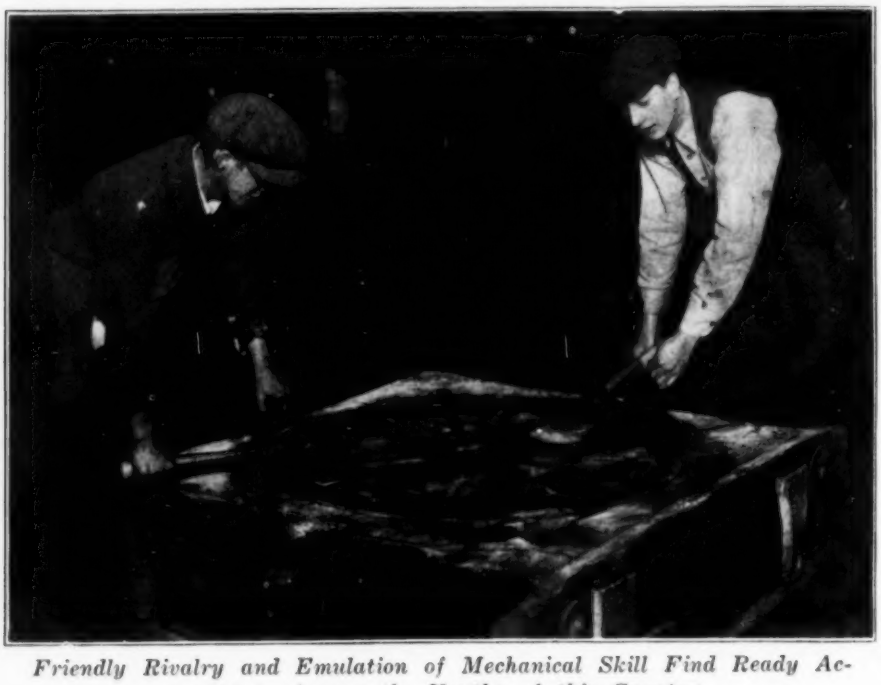
Foundrymen have thought at times that boys would flock into their plant the moment their apprentice plans were announced. It did not take them long to learn the incorrectness of their opinion. The American young man is not disposed by nature to select the foundry business as his life work. Other trades and professions compete for his services. To use a much overworked phrase, apprenticeship must be *sold* to young men just as castings are sold to customers and the young men must be kept sold even as the customer must be kept sold, and the methods of selling the boy are similar to the methods used in selling a product.

The foundryman who made castings with little regard for the needs of possible customers and piled these castings in his yard without first finding out what kind of castings are in demand and without going out to call upon the trade, would not be successful, especially if his business was newly established. The customer must be solicited and so must the boy. The customer must be shown why he should buy castings and the boy must be shown

Molding Should Be Taught As an Art Instead of Merely Another Form of Tedious, Heavy Labor

why he should become an apprentice in the foundry. Both must be shown by similar methods.

The salesman always works upon a definite and carefully planned campaign. He makes a long and careful study of the trade and of individual customers. He studies their nature, their needs and requirements, their tendencies, enthusiasms and prejudices. He develops a wide acquaintance among metal trades manufacturers with a view to developing future purchasers. He makes every effort to have his corporation well and favorably known. He does not say "our castings are thus and so," leaving the buyer to take them or not according to whether or not he can use them. Rather, he is careful to provide castings precisely according to specifications. Also, the salesman is careful that the customer remains satisfied, not only for the sake of his future orders, but also because his good word may attract other customers.



Friendly Rivalry and Emulation of Mechanical Skill Find Ready Acceptance Among the Youths of this Country

The foundryman who wishes to establish apprentice training needs to take the American boy as seriously as he takes his customers and he will have to approach the boy in about the same manner as he approaches the customer. As he studies his customer, so must he study the modern young man. He cannot proceed on the assumption that the young man of today is in all respects similar to the young men of his own day. Essentially they may be the same but their habits and attitudes are much different. He cannot even judge the modern young man by his own boy at home because *own boys* invariably are quite different. He must plan his apprenticeship courses for the young man as he is, not as the foundryman thinks he ought to be, even though the young man as he is may not merit his full approval.

When the employer has studied the American young man, he will find him possessed of certain traits and peculiarities which must be taken into account. In the first place, the modern young man is highly sophisticated, he is informed both as to good and evil, he *knows what is going on.* The modern young man matures early in some departments of his mental machinery. He may be slow in acquiring book learning, but he is quick in acquiring sound judgment. He is critical, skeptical, and frequently suspicious. He understands fairly well the world's work and the relations of its multitude of activities. He knows where opportunities offer and where the best opportunities may be found even though he does not always avail himself of them.

Again, he is much of a boy. He is a hero worshipper and he has definitely made up his mind what kind of occupations are desirable even though he has not determined which occupation he himself will follow. He reads a great deal, looks at many pictures in newspapers and magazines and attends motion picture performances. All these agencies play up the men in commercial pursuits. The real hero of modern fiction and romance is the salesman, the financier, the industrial leader who, somehow or other, is promoted from school directly into a beautifully furnished office with private secretaries and decanters of iced, distilled water at his elbow. The worker seldom is made the hero or, if he occasionally does assume that role, it is always with some qualifications so that the young man, while he admires the toiler as a *he* man and a regular fellow, just as he might admire a pirate or a daring soldier, nevertheless, determines that the toiler's work is not for him.

Again, the young man has heard so much of fortunes made quickly that he is not much attracted by the idea of working his way up slowly and steadily in an industry. He considers it more important to be clever than industrious. Also, he much admires everything that is modern, up to date and *snappy.* The conservative does not attract him. It is needless to add that our modern boy does not take kindly to physical work. He will do it, temporarily, but only if he is firmly convinced that he can do other work in the future and not too distant future either. Finally, an important trait of the young man of today is his personal neatness. During eight or twelve years of school he has had the lesson of cleanliness drilled into him by word and example and has spent his days in school buildings which were kept spotless so that cleanliness has become a part of his nature.

The foundryman who wishes to engage apprentices must keep in mind these general characteristics of American youth, with any others which may be peculiar to his locality, and must make adjustments accordingly, precisely as he keeps in mind the nature of his customers and adjusts his service accordingly. Before he goes out to solicit the trade he must have something to sell; and before he goes out to hire apprentices he must have a program firmly established and must have his entire organization enthusiastic over the idea. He must first make careful schedules of work based upon trade requirements and must know that this program of work can be carried out, to completion.

He must arrange for related school work by which the apprentice may learn the theoretical side of the industry. Whether this school work is to be done in a shop school, a vocational school or by co-operative arrangement with the public schools, depends upon local conditions. He must lay out a satisfactory scale of wages, high enough to attract young men and to prevent the appearance of exploitation, low enough to make the training and not the pay the chief attrac-

tion of apprenticeship. He must establish an apprentice department and endow it with sufficient dignity to command the respect of officials, supervisors and of the boys themselves.

He must convince himself that this apprentice department is qualified to direct the work of the apprentices and he must determine to keep in personal contact with the apprentice training work, not because his attention will be required but to emphasize continually the importance which he attaches to this department. Finally, he must have convinced every member of his organization of the value and need of apprentice training and of its feasibility in his own plant. Then, and not until then, should the first apprentice be hired. He now has something to sell to the apprentice and he must advertise his apprentice plans as he advertises his product, only in different quarters. Apprenticeship must become as familiar a word in his community as his trademark is to the trade. And it must be associated definitely with the name of his corporation.

The manager will need to get in touch with the schools and with school activities. He must acquire the reputation of being much interested in and a great promoter of educational work and this interest must be genuine. Visits and participation in school activities should make him familiar to the students themselves. He will need to cultivate the acquaintance of principals, superintendents and other school authorities. If he himself, or a representative of his corporation, can address meetings of the teachers' associations it will be greatly to the advantage of all parties interested in training.

At first these addresses may be on general topics. Later, as he becomes bolder and better known, he may discuss apprenticeship directly. After a time he will acquire the reputation of being an authority on apprenticeship and invitations to address meetings of various kinds will be received. No such opportunity should be neglected. Parent teachers' associations obviously are of great importance in this connection as it makes it possible for the speaker to reach parents and teachers at a time when the welfare of the boys is uppermost in their minds. Rotary, Kiwanas and other civic clubs, the Y. M. C. A., Boy Scouts and other organizations of a similar nature should receive attention. Everywhere he must speak honestly and enthusiastically of his trade. He must admit its disadvantages and show how they are being overcome. He must play up its advantages and make the most of them, and he constantly must present an attractive, up-to-date appearance. The old style foundryman who prided himself on being a man of action, and who could dispense with the polish and refinements of life, who maintained that the quality of castings was the thing that counted and not the cut of his clothes, will attract few apprentices. His public appearance and demeanor must compare favorably with that of the banker, the physician, or successful business man.

When the foundryman has attracted boys by these methods he must maintain their interest even as he must maintain the good will of his customers. His knowledge of the American boy will suggest certain efforts in this connection which will assist him in decreasing apprentice turnover. The boy will not brook monotony. Uninterrupted molding or core-making will drive him out of the shop as experience has demonstrated. The molding and core-making must be made attractive just as any manufactured product must be made to appeal to the buyer. For this reason various kinds of special work should be introduced into the program, not merely to keep up the boy's interest, but more because of the additional experience which this work will make possible for the apprentice. Casting checking, annealing, heat treating and furnace work all are valuable.

Working conditions in the plant must be improved as much as possible. The gas, smoke, dust and accident hazards which cannot be separated completely from foundry operation should be minimized to the greatest possible extent. A good rule to follow is for the foundryman to question himself as to whether he would permit his own son to work in his foundry. If he would not permit his own boy to work there, he need not expect anyone else's boy to do so. Locker and washrooms should be provided because the American boy of today will not go to and from work in working clothes. The foundryman who expects his apprentices to appear at a disadvantage on the street compared with their friends in banks and insurance offices will not attract the best boys to his business.

Reports of shop work and school work to parents and teachers are valuable perhaps, not so much as reports, but as an indication of the continued interest of the corporation in the apprentices. Parent and former teachers thus are convinced that the corporation values its apprentices and they will urge the apprentice on when he temporarily may be discouraged. Contests of skill and awards for excellence appeal to apprentices and athletics, entertainments, organizations are of great value.

So much has been written during the past few years regarding the necessity of treating each employe as an individual human being with his own ideals, thoughts and ambitions, that it will be unnecessary to devote space to this consideration. It is sufficient to point out that the ability of the foundryman to deal with apprentices as individuals rather than as a group will be by far the greatest factor in the success of his undertaking.

The foundryman who reads of these various essentials to the success of apprentice training possibly will shrink from the tremendous amount of time and effort which these methods will require. He will say that under these conditions his apprentice department will take up more of his time than his entire business. As long as he thinks so, he is not in the proper frame of mind for the establishment of an apprenticeship course.

Of course, he need not do all this personally, but he will need to have a dignified representative to take his place if he does not himself take part in all these activities. He will need to spend at least sufficient time in building up the public relations of apprenticeship to make it clear that he considers his apprentices a vital part of his organization.

However, if he will spend some time, effort and money on the establishment and maintinence of an apprentice training department and give that department sufficient prestige and influence, he will achieve success beyond expectation.

French To Organize Foundry Congress

Recently at a meeting of the council of the Association Technique de Fonderie de France, Emile Ramas, president, announced the intention of organizing a foundry congress to be held at the same time as the French annual convention in 1927. Foreign manufacturers and foundrymen will be invited to participate. This congress will be organized by the Syndicat General des Fondeurs de France with the co-operation of the French technical association. Emile Ramas, president and A. Damour, first vice president of the French association will represent that institution on the committee named for the organization of the exhibition.

Are You Making Wild Guesses Or Estimates?

False Assumptions on Past Performances Prove Heavy Handicap in Setting Prices for Foundry Work. Detailed Method of Study of Various Departmental Costs Is Suggested

By Albert E. Grover

PROBABLY no document in daily use by the foundryman excells in importance the estimate sheet. Upon it depends the whole fabric of a successful business career. A professor in economics once told his class that some manufacturers based their selling prices on estimates, while others established a sales price through the use of *guesstimates*. "Guesstimates," said he, "are only the wild vaporings of a credulous mind too often influenced by the price established by competition where the same methods are used. Estimates are supported by actual "cost data."

Three methods of making up estimates of cost are prevalent. Briefly they are as follows:

Starting with the average cost per pound of all castings produced, and adding or deducting *guesstimated* amounts to cover variations in cost from the average. This method would be sufficient if the foundryman was lucky enough to guess right at the start. There is only one factor in favor of this method. The cost of clerical help is *nil*. An example of such a method is shown in Table I.

The second method bases the estimate on the average cost of castings of the same class as shown on cored castings weighing between 11 and 20 pounds cost $6.50 per hundred pounds. An example of such a method is shown in Table II. Not much can be said in favor of this method as it does not comprehend the possible variations in coremaking, molding and cleaning. Neither does it have the advantage of low clerical expense as in the first method. The clerical expense is nearly as great as that required to secure cost data on individual jobs.

The third method is applied by basing the costs of the several operations, through which the castings will pass, upon actual cost data. An example of such a method is shown by Table III. A comparison of the results of these three methods is convincing evidence of the unreliability of the first two.

To provide information for use in making estimates, certain accounts must be set up on the books of the company to measure operating activities. Provision also must be made for summing up or closing these accounts, so that such detailed costs are kept, may be applied to the quantity of castings made. Any system of cost finding, whether based on average tonnage, classification, or individual jobs, must be tied in or proved with the general book accounts recording investments in materials, labor and overhead expense, if accurate results are to be expected.

Shoppers Not Buyers

Two distinct types of buyers are doing business with the foundrymen. The one sends a print of the casting or perhaps the pattern to the foundryman asking for quotations on each separate job. The other brings in a collection of patterns covering a variety of weights and shapes, asking for a blanket price per hundred pounds covering all the patterns. The first type, by his action, admits he is shopping for a favorable price. The second conveys the idea that he is willing that the foundryman shall make profit enough on the easy jobs to compensate for loss on hard jobs.

Consider now how the foundryman operating the several bases of estimating previously mentioned will handle this situation and what results will follow.

First consider the man who favors the tonnage basis of estimate. In the case of the individual job quotations he is dependent upon his own guess as to the variations from the average tonnage cost shown by his records. Surely he has made castings similar in weight and shape, but the accumulation of material, labor and expense

Studied Foundries

ALBERT E. GROVER, author of this article, has had more than twenty years of cost accounting experience. He started with the Geneva Metal Wheel Co., Geneva, O., in 1905. *Seven years later he was employed by the firm of Nau, Rusk & Swearingen, Cleveland, certified public accountants. During eight years service with this firm he specialized in foundry systems. His professional contact with the Dunham Co., Berea, O., secured for him the position of comptroller for that castings manufacturing establishment. In* 1921 *he returned to the professional field, being employed as cost manager by Kohr, Brubaker & Fisher, Cleveland, leaving a short time later to establish a cost accounting practice in his own name.*

Table I

Tonnage Cost Estimate

Average cost per hundred pounds	$ 5.00
Weight of finished castings	2000
	$100.00
Added to cover excess cost	25.00
	$125.00
Freight Out 2000 pounds at 0.06 per cwt.	1.20
	$126.20
Profit at 10 per cent	14.02
Sales price	$140.22

Table II

Classified Cost Estimate

Average cost per hundred pounds for this class	$ 6.50
Weight of finished castings	2000
	$130.00
Freight out 2000 pounds at 0.06 per hundred pounds	1.20
	$131.20
Profit at 10 per cent	14.57
Sales price	$145.77

cost separately for these castings, seemed an unnecessary expense. He must now take a long shot at a price and trust to luck in securing the business, or in some manner learn the quotation of his competitor. Here is the uneconomic phase of the situation. His competitor makes a price (and no one knows whether it is right or wrong), and the *guesstimator* promptly underbids him. Perhaps other foundrymen get into this bidding game until the price of the job has been reduced to a point where profit is impossible. Suppose he stands pat on a job where his guess is more than the actual cost to produce. He certainly will lose profit eventually through the loss of future business.

Now, what about the *Good Samaritan* who favors the buyer with an order for all his business. With this kind of a sales policy can he not enjoy life? Has he not saved the cost of a clerk and relieved himself of the annoyance of analyzing cost data?

While he slumbers on in blissful ignorance, a competitor slips into the picture like a thief in the night, and takes away certain profitable jobs. This competitor knows the cost to make each job, so the unprofitable jobs are not interesting to him and he leaves them where they are. Thinks the tonnage price foundryman to himself:

"Why should I worry? I can go into the field and bring in more jobs to replace those taken away. I shall have a good portion of the old customer's castings in the sand. Look at that heavy casting, it weighs 500 pounds and makes up for the loss of ten 50-pound castings that my competitor took away. Can anyone question my conclusions? Have I not been in business for so many years that my experience outweighs any conclusions that a mere cost clerk can secure from a cost system?"

Stop! Let's analyze his judgment.

Assuming he has an order for 100 of the 500 pound castings, and the order for 50 pound castings, that he lost, called for 1000 castings. Assuming further that the actual production cost is obtainable, the results of the transactions would be:

	500 pound contract	50 pound contract
Weight ordered	50,000	50,000
Price per 100	$ 6.00	$ 5.00
Cost per 100	8.00	4.00
Price received	3000.00	2500.00
Cost	4000.00	2000.00
	*$1000.00	†$500.00

*Loss. †Profit.

Has he saved the expense of a clerk? The 500 pound casting is a difficult one to make, and he loses $1000 on the order, in spite of the fact that his tonnage costs show a profit. If he loads his foundry with this job he soon will be out of business. His loss has been increased by giving away the profitable order for the 50 pound castings.

Bunching Them Together

Consider next the foundryman who bases his estimates on classified castings costs. He has little advantage over the one using a flat tonnage basis.

Referring to Table II, the base for estimating is $6.50 per hundred pounds, which is the average cost for all cored castings between 11 and 20 pounds. Of the $6.50, the only part of the cost that fluctuates rela-

Table III

Individual Job Cost Estimate

		Pounds	
100 castings, pattern X, weight—Mold		3000	
—Gate and sprue		1000	
—Good cast		2000	
MELTING COST			
Metal at spout, 3000 pounds at $1.60 per hundred-weight		$48.00	
Less—Gates and sprues, 1000 pounds at $1.00 per hundred-weight		10.00	$ 38.00
CORE MAKING COSTS			
Material		3.00	
Labor, 10 hours at $0.70		7.00	
Expense, 10 hours at $1.50		15.00	25.00
MOLDING COST			
Labor, 20 hours at $0.90		18.00	
Expense, 20 hours at $1.75		35.00	53.00
CLEANING COST			
Milling, 2000 pounds at $3.50 per 1000 pounds		7.00	
Labor—Grind, 4 hours at $0.60		2.40	
Expense, 4 hours at $0.80		3.20	12.60
EXTRA			
Mount on plate—Material		4.00	
—Labor, 5 hours at $1.00		5.00	
Expense, 5 hours at $0.60		3.00	12.00
			$140.60
RETURNS			
Foundry	5% 5		
Customer	1% 1		
6 at $1.41		8.46	
Less—Remelt value, 120 pounds at $1.00 per 100 pounds		1.20	7.26
DISTRIBUTION COST			
			$147.86
Shipping 2 per cent		3.28	
Selling 8 per cent		13.15	16.43
			$164.29
PROFIT, 10 per cent			18.25
FREIGHT OUT, at $0.06 per hundred-weight			1.20
SALES PRICE			$183.74

tively with the weight of the casting, is the cost of the iron at the spout amounting to $1.60 or approximately 25 per cent of the total cost. The actual cost of labor and expense to make this particular casting is considerably above the average for the class, as shown by the actual cost of $8.21 in Table III. It is not uncommon for a casting with a simple core to cost less than a plain casting of the same weight.

Results from such a system of data collection cannot be otherwise than misleading, as too great a chance is offered for fluctuation in labor and expense between jobs in the same class.

The direct labor for coremaking, molding and cleaning is the most expensive item of cost to obtain. To insure accurate classified costs, the labor must be accumulated by these classes. As men employed to perform these operations are changing from one class to another almost as often as the jobs change, the saving in timekeeping is not materially reduced from labor cost for individual jobs.

Knowledge is power, profitably may be written into the business ethics of the foundry industry. The foundryman who bases his estimates of cost on the accumulation of actual material, labor and overhead expense data for individual jobs certainly has the knowledge, which, coupled with good business sense, contributes toward establishing sales prices that are just to the consumer and profitable to the castings manufacturer.

It must be admitted that cost records of individual jobs require clerical effort and care must be exercised to eliminate the unnecessary expense in accumulation and distribution. There is a shortest way to secure individual job costs, and the foundryman does his organization a serious injustice if he does not try to find that way.

How to Start

To secure information necessary to make estimates of individual jobs, as illustrated in Table III, the foundry is divided into physical departments as follows:

Melting
Coremaking
Molding
Cleaning
Pattern & Flask
Shipping
Selling

Each of these departments has its own particular function, and all materials, labor and overhead expenses incurred by each must be charged to the product on a basis representing the department activities. The following discussion will give an idea of the items chargeable and how they should be handled.

Table IV

Classified Costs

Plain castings	Cost per cwt.
10 pounds and under	$4.00
11 to 20 pounds	$3.75
21 pounds and over	$3.50
Cored castings	
10 pounds and under	$7.00
11 to 20 pounds	$6.50
21 pounds and over	$5.50

MELTING—The function of the melting department is to prepare the iron, coke and flux for melting, melt the iron and pour it into molds. The product of this department is designated as metal at the spout, and is chargeable to individual molds on the basis of weight. Many foundries make several mixtures of iron to conform to the texture of the finished castings as required by the consumer. The variation in cost of these mixtures is caused by the fluctuation of material values. Labor and overhead expense costs being constant, a tonnage cost for these mixtures easily may be computed for distribution to the castings using each mixture.

Credit is given individual molds for the remelting value of the iron contained in gates and sprues. In some cases where the variation, in percentage of gates and sprues to total weight of molds is not great, the total cost of iron at the spout is distributed to the good castings produced thus saving on operation of cost finding.

Table V

Cost of Metal at the Spout

Cost of iron per ton	—Total Cost per Hundred Pounds Melted— 8 Tons	10 Tons	12 Tons	14 Tons	16 Tons	18 Tons
$18.00	$1.16	$1.15	$1.14	$1.14	$1.13	$1.12
20.00	1.26	1.25	1.24	1.24	1.23	1.22
22.00	1.36	1.35	1.34	1.34	1.33	1.32
24.00	1.46	1.45	1.44	1.44	1.43	1.42
26.00	1.56	1.55	1.54	1.54	1.53	1.52
28.00	1.66	1.65	1.64	1.64	1.63	1.62
30.00	1.76	1.75	1.74	1.74	1.73	1.72

For convenience in making estimates, a table of metal at the spout rates per hundred pounds, fluctuating with the market prices of pig iron and various volumes of production, is shown in Table V. The method of arriving at these costs is shown in Table VI.

COREMAKING—The distribution of the actual operating cost of cores to the proper jobs is not a simple task and for that reason many times is neglected. However, the inclusion of *guesstimated* core costs in the estimate to establish a sales price often is responsible for losses that are buried in the accumulation of averages and never become known. On the other hand, the same *guesstimated* methods may result in a price too high to secure profitable business.

Cores Cost Money

It it not uncommon for the coremaking cost of a job to be greater than the cost to mold the casting. Therefore, the importance of its proper consideration is conclusive.

To obtain authentic information as to the core costs for inclusion in estimates, the normal cost per pound of sand mixtures is known. Foundrymen using this method are in touch with their core department activities, and can compare the size of the core in the casting being estimated with other castings having a similar core. The weight of the core in the latter casting being known, the weight of the core being estimated is determined close enough for practical purposes. Then it becomes simple to multiply the weight by the normal cost per pound to determine the core material cost.

The same comparative method is employed for the determination of time required to make cores. The labor hour is multiplied by the average wage rate of employes doing that class of work resulting in the estimated labor cost. The same measure of time as used for labor computation, also is multiplied by the normal overhead expense rate of the core department to determine the core expense for the estimate. The principles underlying core expense determination are similar to those for molding, and are set forth under that caption.

MOLDING—The estimate of molding cost deals with labor and overhead expense costs in the main and new sand, blacking, nails, chaplets, etc. are included with overhead expense.

The time required to make the molds is determined by comparing the jobs under consideration with the time on jobs of a similar character

made previously, coupled with the good common sense of the foundryman. The time is multiplied by the average hourly rate of molders on this class of work. Piece and bonus rates, where used, always are based upon time. So the inclusion of that element in the estimate does not change the procedure.

The overhead expense for the estimate is determined by the multiplication of the molding hours by the normal hourly expense rate for the molding department. The rate used in the example covers the department as one production unit. However, conditions arise in some foundries where the investment in molding machines is a decided factor in cost determinations. In such cases a flat department rate is misleading, as the excess investment cost, to operate high priced machines over the investment cost to operate the department with inexpensive machines, is not paid ultimately by the customer.

Table VI

Estimating Metal Costs on Iron at $24 a Ton

Tons melted daily	8	10	12	14	16	18
Material	$ 50.53	$ 63.18	$ 7,576.21	$ 8,845.00	$10,101.00	$11,370.00
Labor	600.00	700.00	832.08	1,000.00	1,200.00	1,300.00
Expense						
Depreciation	115.88	115.88	115.88	115.88	115.88	115.88
Taxes	14.67	14.67	14.67	14.67	14.67	14.67
Insurance	1.61	1.61	1.61	1.61	1.61	1.61
Interest	83.15	83.15	83.15	83.15	83.15	83.15
Maintenance	95.00	97.00	99.44	102.00	104.00	106.00
Light	4.86	4.86	4.86	4.86	4.86	4.86
Power	28.00	35.00	41.57	48.00	54.00	60.00
Time keeping	30.00	30.00	30.00	30.00	30.00	30.00
Supplies	14.00	15.00	15.92	16.00	17.00	18.00
Small tools	9.00	10.00	10.67	12.00	13.00	14.00
Accident expense	8.65	10.10	11.98	14.42	17.30	18.75
Experimental	34.00	34.00	34.50	34.00	34.00	34.00
Prop.—Gen. Fdry	79.30	92.60	110.05	132.20	158.65	171.90
Total	$ 518.12	$ 543.87	$ 574.30	$ 608.79	$ 648.12	$ 672.82
Grand total	6,171.00	7,561.00	8,982.00	10,453.00	11,949.00	13.342.00
Cost for one day	237.00	291.00	346.00	402.00	460.00	513.00
Cost per hundred pounds	1.46	1.45	1.44	1.44	1.43	1.42

The overhead expense rates used in figuring the estimate are based upon a careful study and logical application of the following principles:

BUILDING EXPENSE—
A place for the men to work.

EQUIPMENT EXPENSE—
Tools with which the men work.

GENERAL EXPENSE—
Supervision and clerical effort necessary to plan and record the activities of the men, and other expense required to maintain the department.

The building expense total is divided into departments in proportion to the floor area occupied by each, and this amount included with the other classes of expense to determine a rate for cost distribution. The equipment expense is charged directly to the department expense where the equipment is used. This class is divided further by machines where the conditions require such a division.

All expenses coming under the *General Expense* class, such as indirect labor, supplies, accident expense, moving materials, cutting sand, etc. are charged to departments where incurred. Those expenses that are of service to all foundry departments are distributed to those departments in proportion to the service rendered each. Overhead expenses, other than those concerned with melting iron and milling, do not fluctuate with tonnage produced, and any method of applying them to cost of individual castings by weight constitutes lost effort.

CLEANING—Castings that will go into tumbling mills are cleaned in this manner. However there is additional work of chipping and grinding on some of them, as well as chipping and grinding on castings too large to go into the mills. The labor for milling is segregated from the other labor in the department. To this cost is added the overhead expense caused by this operation, and the total distributed to individual jobs on a tonnage basis. This method is not true to principle, yet experience has proved that the method is practical with little loss of accuracy.

The chipping and grinding labor is kept by individual jobs and included with the overhead expense, applied on the basis of production hours, for entry to cost of castings cleaned.

In the estimate illustrated, the casting requires no sandblasting. However, if the estimate required the cost for sandblasting, the hours, labor and overhead expense for the operation would be shown in a manner similar to chipping and grinding. All expense for sandblasting, except direct labor, are included in the overhead expense.

EXTRAS—Nearly every foundry maintains a department for pattern and flask work, both new and repairs. Work often is performed in this department that is chargeable to the customer or to other divisions of the same company. That service of this department may be measured equitably, and charged properly, the material, labor and overhead expense costs are accumulated by production orders. This procedure allows invoicing of work, outside of the foundry maintenance, with the entire cost of the job included. This procedure also provides a segregation of pattern costs for individual jobs, thus eliminating one more average cost inaccuracy.

It is a common practice among foundrymen to mount several patterns on a plate, thus effecting the time required in molding. The cost of doing this work is extremely important in making estimates, if the foundryman meets competition intelligently.

RETURNS—The loss of labor and overhead expense accruing through the return of defective castings, varies distinctly among the different jobs. Some jobs are found to be efficiently produced with a return of 20 per cent defective while other jobs showing a return of 5 per cent defective calls for immediate investigation. The most exacting inspection at the foundry will not disclose all the defects in castings and returns from the customer must be accounted. Records of these returns are made a part of the individual cost records, not so much for use in holding post mortems on the jobs completed, as to furnish data for future estimates. Before charging to individual job costs, the costs of returned castings are credited with the value to remelt.

In making estimates uncertainty arises as to the number of castings that will be returned as defective, yet with a record of the returns kept by individual jobs, a valuable service is rendered to the individual making estimates for sales prices.

SHIPPING—The cost of shipping castings is added to estimates on a percentage of volume to the total volume shipped. This cost, made up of miscellaneous items of crating lumber, packing and handling labor, overhead expense of the shipping department and clerical effort in making out weigh bills etc., covers so many different bases of distribution, that the most practical basis of individual job distribution is on volume of busi-

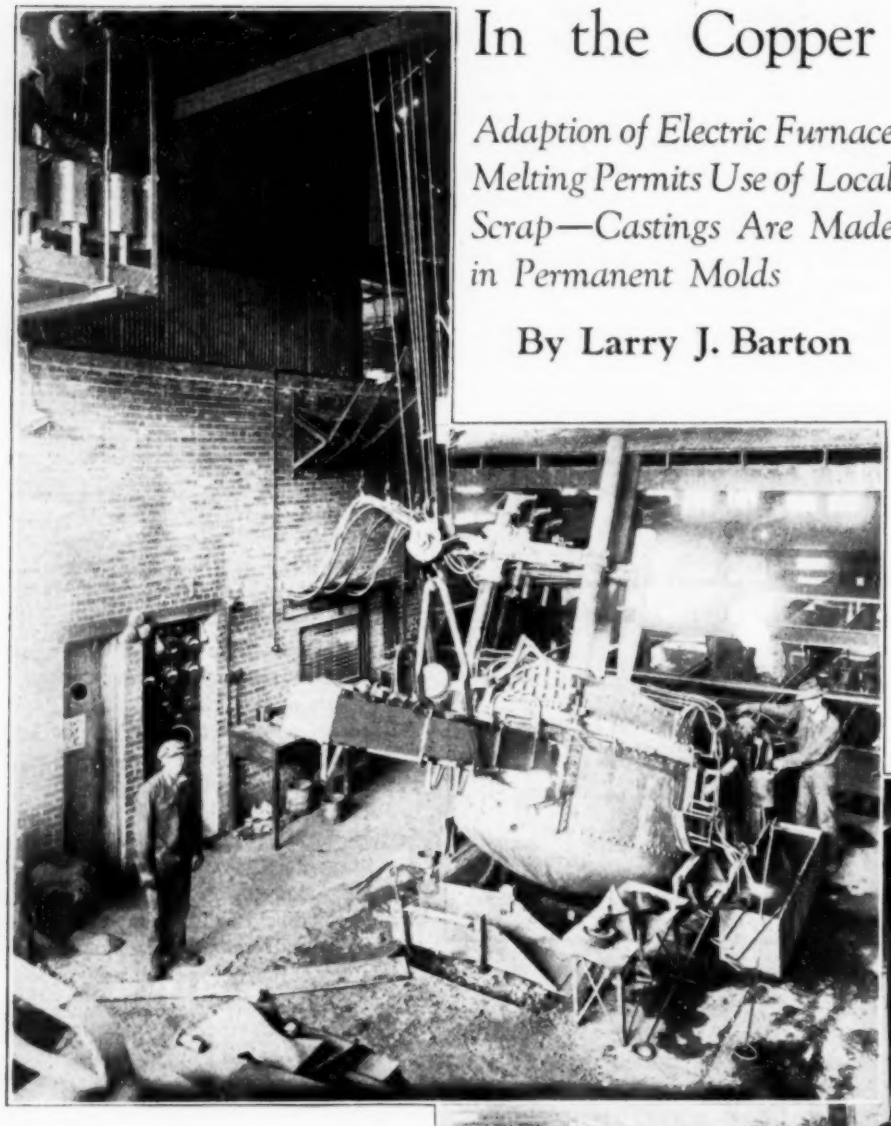
(*Concluded on Page* 325)

Making Hard Iron Balls

In the Copper Mining Country

Adaption of Electric Furnace Melting Permits Use of Local Scrap—Castings Are Made in Permanent Molds

By Larry J. Barton



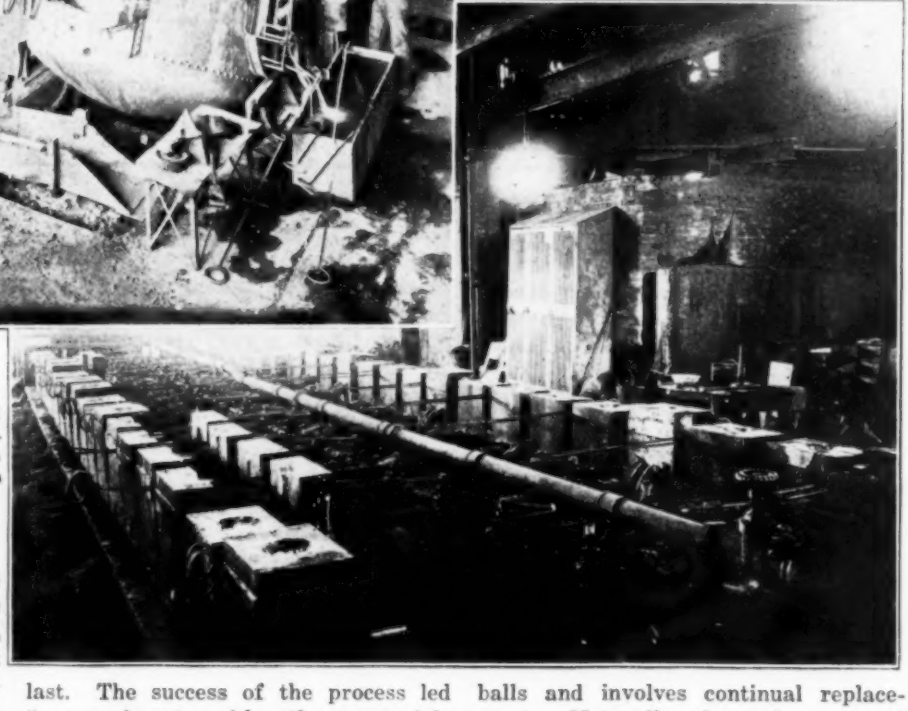


Fig. 1—Above—The charge is weighed in a steel pan and then dumped into the furnace. Fig. 2—Right—The iron molds are arranged in two batteries with the operating hydraulic cylinders in between

MINING in its various phases today absorbs a large tonnage of various kinds of castings, the greatest amount going to different abrasive resisting shapes used in ore grinding operation. The larger proportion of the hard casting tonnage is represented by grinding balls which reduce the coarse ore to its final pulverized state in which it is treated in the final flotation process.

Use of hard iron balls in grinding or ball mills is of fairly recent origin. The first media employed for the purpose were hard smooth pebbles brought from Europe as vessel ballast. The success of the process led to experiments with other materials with the result that the hard, cast-iron ball was found to be far superior in grinding efficiency.

Copper ore as it comes from the mines is fairly coarse, since the only requirement is that it shall not exceed a size that readily may be handled by a steam shovel. Rough grinders reduce this ore to a size not exceeding 2 inches. A second set of rough grinders reduces it still further so that it will pass through a screen with 6 meshes to the inch. This comparatively fine material then enters the ball mill where it is reduced to a powder 10 per cent, plus 48 mesh, which means that 90 per cent passes through a screen having 48 meshes to the inch.

The ball mill is lined either with hard iron or manganese steel castings held in place by lifting bars about 4 inches square and ranging in length from 18 to 26 inches. The grinding balls in the revolving mill are carried upward constantly by the lifting bars and dropped back on the charge of ore. The balls slide rather than drop and the combined rubbing and dropping rapidly pulverizes the ore which then automatically passes out through the lower end of the mill into a stream of water. This severe service rapidly wears both liners and balls and involves continual replacement. Naturally the only material suitable for these castings of this character is one that can resist abrasion and impact.

Up to the present, grinding mill balls have been made either from cupola white iron, malleable white iron or from forged and hardened steel. The writer has developed a new ball metal during the past year which presents points of merit over other met-

METHODS FOR ANALYZING FERROALLOYS

FERROMANGANESE

(*Continued from Data Sheet No.* 616)

NOTES

1. Chromium when less than 2 per cent does not cause any interference if the reactions are rapidly done in cold solutions. Larger amounts interfere to some extent and should be separated prior to the final oxidation with bismuthate.

2. The gravimetric determination of manganese by the pyrophosphate method will give high values if the precipitate of manganese ammonium phosphate is allowed to stand more than ten hours before filtration.

3. Volumetric methods such as Volhard's, Ford-Williams' and Julian's do not permit the use of a theoretical titre. Each necessitates the use of an empirical titre obtained by titration of material of known manganese content which has been carried through all steps of the method.

Determination of Carbon by the Direct Combustion Method

See the determination of carbon in ferrochromium by the direct combustion method. A furnace temperature of 1050 to 1075 degrees C. suffices, and high-silicon material should be covered with 1 or 2 g. of ingot iron.

Determination of Phosphorus by the Alkalimetric Method

SOLUTIONS REQUIRED

Dilute Nitric Acid (sp. gr. 1.135).—Mix 300 cc. of HNO_3 (sp. gr. 1.42) and 700 cc. of distilled water.

Ammonium Molybdate.—See the determination of phosphorus in ferrovanadium by the modified molybdate-magnesia method.

Standard Sodium Hydroxide.—Dissolve 6.5 g. of purified NaOH in 1000 cc. of distilled water, add a slight excess of a 1-per cent solution of $Ba(OH)_2$, let stand for 24 hours, decant the liquid and standardize against bureau of standards standard benzoic acid as follows: Dissolve 0.6 g. of benzoic acid in 15 cc. of alcohol in a small Erlenmeyer flask and titrate in the cold with phenolphthalein indicator, taking precautions to prevent access of carbon dioxide from the air during titration. The ratio of phosphorus to sodium hydroxide is taken as 1 to 23 in calculating the value of the sodium hydroxide. Protect the solution from carbon dioxide with a soda-lime tube.

(*Continued on Data Sheet No.* 618)

METHODS FOR ANALYZING FERROALLOYS

FERROMANGANESE

(*Continued from Data Sheet No.* 617)

Standard Nitric Acid.—Mix 10 cc. of HNO_3 (sp. gr. 1.42) and 1000 cc. of distilled water. Titrate the solution against the standard hydroxide solution, using phenolphthalein as an indicator. Adjust the solution so that it is equivalent to the sodium hydroxide solution.

Dilute Ammonium Hydroxide (sp. gr. 0.96).—Dilute 400 cc. of NH_4OH (sp. gr. 0.90) with 600 cc. of water. The strength of this solution should be established by titration or test with a hydrometer.

METHOD

Dissolve 2.000 g. of the sample in 70 cc. of nitric acid (sp. gr. 1.42), evaporate to dryness and bake for two or three hours at 120 degrees C. High-silicon alloys may require the addition of a little hydrofluoric acid for complete decomposition. In this case, several evaporations with 15-cc. portions of nitric acid (sp. gr. 1.42) should be made to remove hydrofluoric acid before the baking treatment. Moisten the residue with 25 cc. of dilute hydrochloric acid (1:1), digest a few minutes, (addition of a little sulphite or sulphurous acid facilitates solution after baking treatment) add 75 cc. of water, heat until the salts are dissolved and then filter to remove silica. Evaporate the filtrate to a syrupy condition, add 15 cc. of nitric acid (sp. gr. 1.42) and again evaporate to a small volume. Again add 15 cc. of nitric acid (sp. gr. 1.42) and evaporate to a small volume. Add 100 cc. of nitric acid (sp. gr. 1.135), heat to boiling and add a 1.5-per cent solution of potassium permanganate until oxides of manganese are precipitated. Dissolve the oxides of manganese by addition of sulphurous acid and boil to expel the oxides of nitrogen. To the cold solution add 40 cc. of NH_4OH (sp. gr. 0.96) and 50 cc. of ammonium molybdate solution and shake for 5 minutes. Allow to settle for 10 minutes; for material containing less than 0.02 per cent of phosphorus, allow to stand 30 minutes. Filter and wash 10 times with a 1-per cent solution of KNO_3. Return the precipitate and paper to the precipitating vessel, add 1 to 3 cc. in excess of standard NaOH solution and 25 cc. of water, both free from carbon dioxide, and shake or stir until the precipitate is dissolved. Dilute to 100 cc. with water free from carbon dioxide, add 3 drops of a 0.2-per cent solution of phenolphthalein, and discharge the pink color with standard acid. Finish the titration by adding standard alkali until the reappearance of the pink color. With very low phosphorus material this titration should be corrected by a blank carried through all steps of the method.

NOTE

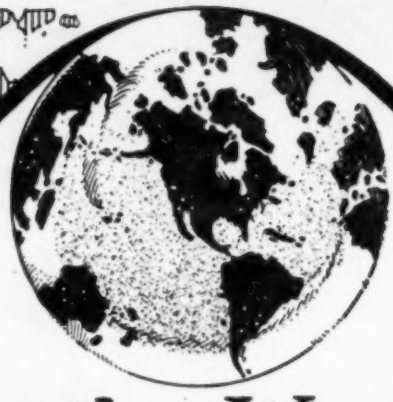
If vanadium is present in amounts over 0.08 per cent it should be reduced by ferrous sulphate and sulphurous acid before precipitation with molybdate.

(*Concluded on Data Sheet No.* 619)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, APRIL 15, 1926

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication



Around the World with The Foundry

Little Journeys to the homes of our readers

Portugal

CENTURIES ago Vasco da Gama battled his way around the stormy Cape of Good Hope, laid a course across the uncharted Indian ocean and was the first white man to return by the same route with a cargo of Eastern treasures from the far famed ports of the Indies. How his adventurous spirit must have rejoiced recently when two of his countrymen, worthy descendants of a long line of gallant navigators, hopped off from their native land on the longest transatlantic flight yet attempted by man.

In the great harbors of Lisbon and Oporto, which once hummed day and night with the activities of foreign commerce, an occasional big freighter now ties up to a dock, swings out her cargo booms and proceeds to discharge a miscellaneous collection of goods from an apparently inexhaustible interior. After the cargo is discharged the big booms once more creak and sway, the donkey engines puff and strain while depositing tier on tier of the barreled red wine of Oporto, marked for export.

Although endowed with a considerable degree of mineral wealth the absence of coal has materially hindered manufacturing progress. The greater part of the machinery requirements are imported, but 25 foundries are listed in operating and in 3 of these THE FOUNDRY is a welcome visitor twice a month.

"Wherever metals are cast you'll find THE FOUNDRY"

als formerly employed by the Nevada Consolidated Copper Co., McGill, Nev.

Several years ago a serious fire in the concentrator plant of this company left many thousand tons of structural steel scrap and various other kinds of worn out material on hand. This scrap could not be shipped out profitably on account of the long haul between McGill in the mountains of Nevada and the nearest scrap market and consequently it represented a dead loss. J. C. Kinnear, assistant to the general manager, decided that the electric furnace was capable of converting this useless scrap into a useful product and to that end he installed a 1½-ton furnace made by the Pittsburgh Electric Furnace Corp., Pittsburgh. The furnace was set up in the old gray iron foundry and during the past year amply has justified its selection.

The writer was engaged to take charge of all operations in connection with the furnace and to develop metals peculiarly adapted for use around the mill and the plant in general.

Gas Inclusions

At first the furnace only was operated intermittently. The cupolas melted all the gray iron and ball metal required. Preparation was made to take over the entire load as soon as possible and within three weeks two shifts were turning out nine heats a day. Gradually the entire casting production load was taken over by the electric furnace and the cupolas were abandoned. Probably they never will melt any more metal except in an emergency when the electric furnace may be out of commission temporarily. The production of gray iron first was standardized and then the development of ball metal was started.

In a study of previous mill experiences we found that during the past few years every kind of a manufactured grinding ball had been tried. Choice finally had settled on the product of the company's own cupolas. It was as good as any of the others and much cheaper. The forged steel ball would not crush or spall, but the wear was rapid. The malleable ball was brittle and showed a tendency to flake or spall in service. Imported balls made from cupola melted metal were no better than those made in the company's foundry. In other words a record of tests over a long period indicated that the ball made locally from cupola metal was as good as any brought in from outside.

Three main points had to be proved to justify the installation of the electric furnace: The ball must be better than the cupola product, it must be made from the steel scrap on hand, its cost must be lower or at best no higher than the present cost for cupola metal. With these various factors in mind the cupola balls were examined closely as a base on which to plan development. The metal was sufficiently hard, they were fairly tough and resistant to impact. Their only weak point was that they were not solid, but contained gas inclusions. These inclusions were of such a character that the ball was weakened. It could not yield 100 per cent service even though the metal was perfect.

Experiments were tried with cupola metal to determine if this gas could be eliminated. Every known expedient was tried but without success. This lead seemed to furnish an opportunity for the electric furnace, but when the experiment was tried some difficulty was experienced at first.

The charge was made exclusively of steel scrap with sufficient coke added to raise the carbon to a white iron analysis. It was extremely difficult to hold a slag on this iron and the customary method of making the slag kill the gas would not work. Ferromanganese was tried without success, various temperatures were tried. The metal was poured hot, medium and cold. Silicon additions were tried but they only softened the iron without affecting the gas inclusions. After many trials a method was found for holding the slag on the metal and this slag eliminates all traces of gas. The entire process as now practiced is based on this method of handling the slag.

The manufacture of balls became

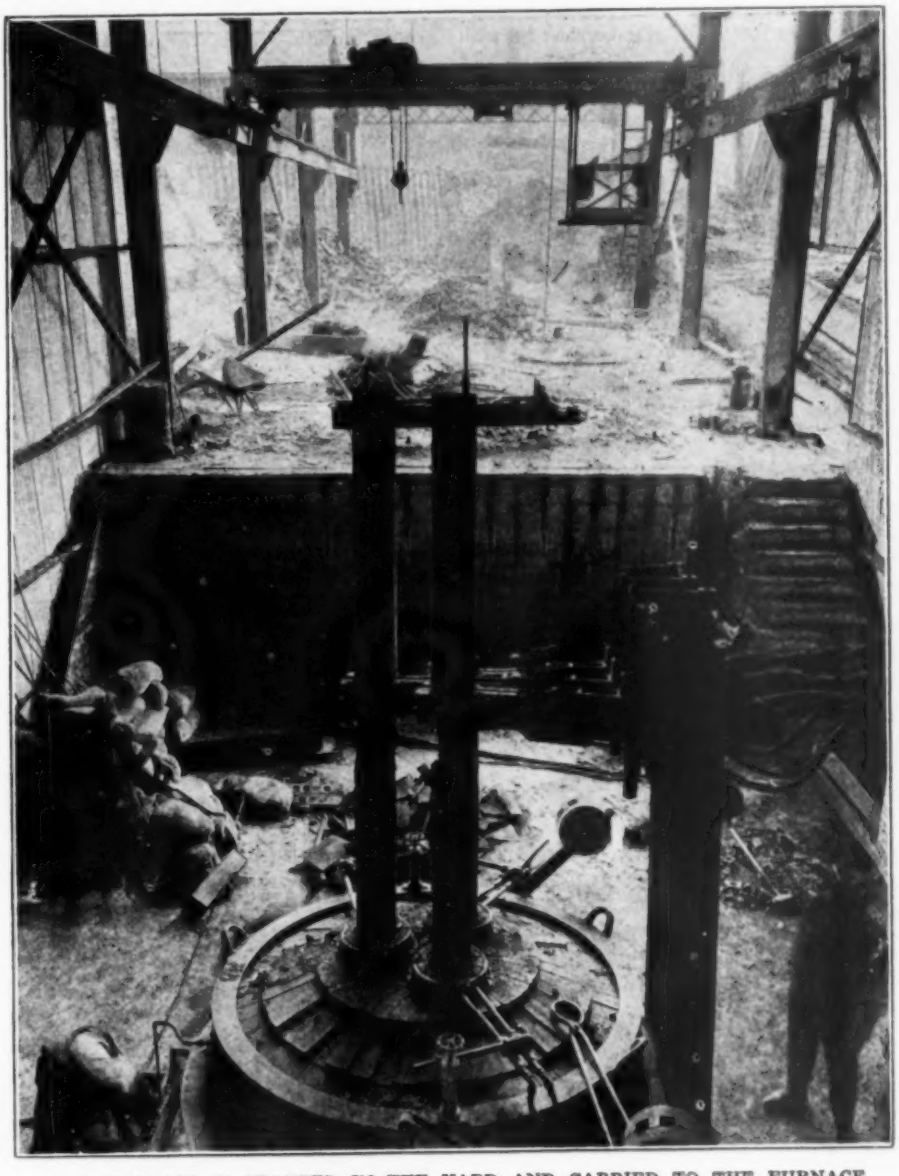


FIG. 3—SCRAP IS STACKED IN THE YARD AND CARRIED TO THE FURNACE WITH A TRAVELING CRANE THAT SPANS THE BUILDING

simplified. Solid metal is obtained regularly not only for balls but for any hard iron castings. Castings formerly impossible of production from cupola iron easily are made from metal melted in the electric furnace. The new ball metal is extremely hard and tough. Figures for the old cupola ball indicate that 2.2 pounds of balls were consumed for every ton of ore pulverized. Figures for the electric furnace ball show that this 2.2 is reduced to 1.25 or an added grinding efficiency of 45.5 per cent. In other words a little over half the number of balls formerly required are used to pulverize a given quantity of ore. The exact figure is 54.5 per cent. Approximately this same proportion holds on other hard iron castings used around the plant. Many castings formerly poured with gray iron now are made from white iron melted in the electric furnace.

Furnace Layout

Final product now standardized is made entirely from steel scrap with small additions of alloys and sufficient coke to supply the carbon. Chrome, nickel and other alloys are not used. Additions are confined strictly to the ordinary requirements, silicon, manganese, etc. The slag process controls the melting procedure and all additions are made to the charge in the furnace.

Scrap is brought in on a high line in side dump cars and dumped over the bank into the scrap yard where the correct amounts are weighed into buckets and brought into the furnace as shown in Fig. 3. Method of charging the furnace is shown in Fig. 1 while the molding floor on a lower level may be noted in the background. The furnace is tapped into a 1000-pound capacity ladle resting on the floor of an elevator which takes it down to the pouring floor. Here the metal is transferred to two 500-pound capacity ladles used in pouring the ball molds. The large ladle is returned to the furnace for a second and third tap for each heat. Each of the small ladles is suspended from a patented pouring device and is operated by one man. Detail of the mold arrangement and the pouring equipment are shown at the extreme right in Fig. 4.

Use of iron molds for making chill balls is not new, but the arrangement shown in Figs. 2 and 4 presents an improvement over previous methods. Usually chill molds are held together by a cam, a latch or some other form of mechanical appliance. The method is crude and does not take care of the expansion and contraction of the metal and besides it requires physical labor to operate. In the ball molds shown in the illustrations the molds are opened and closed hydraulically. The molds are arranged in two rows for convenience in pouring. They are split vertically with the outside half of each mold fastened rigidly to a foundation while the inside half is attached to the plunger of a hydraulic cylinder and mounted on slides. The valves operating the cylinders are controlled by long handles projecting past the molds on either side of the battery within easy reach of the attendant who alternately opens and closes the molds.

Coated With Oil

After each heat has been poured, the molds are opened and the balls fall on to a convyor which discharges them into a tumbling mill which removes any fins or gates. From the open end of the mill the balls fall down a chute into a waiting railroad car which takes them to the pulverizer station. Before the molds are closed for a heat they are brushed clean to remove any particles of iron which might prevent them from closing tightly. Many protective coatings have been tried on the face of the molds, but a light oil wash has given the best satisfaction. The molds are made from a soft, open grained gray iron melted in the electric furnace.

During 1925, a total of 2923 heats of metal was melted in the electric furnace, 71 steel, 522 gray iron and the remainder hard white ball metal. Power consumption averaged 545 kilowatt hours per ton, 570 on the ball heats and 455 on gray iron. Electrodes averaged 14 pounds of carbon

(*Concluded on Page* 322)

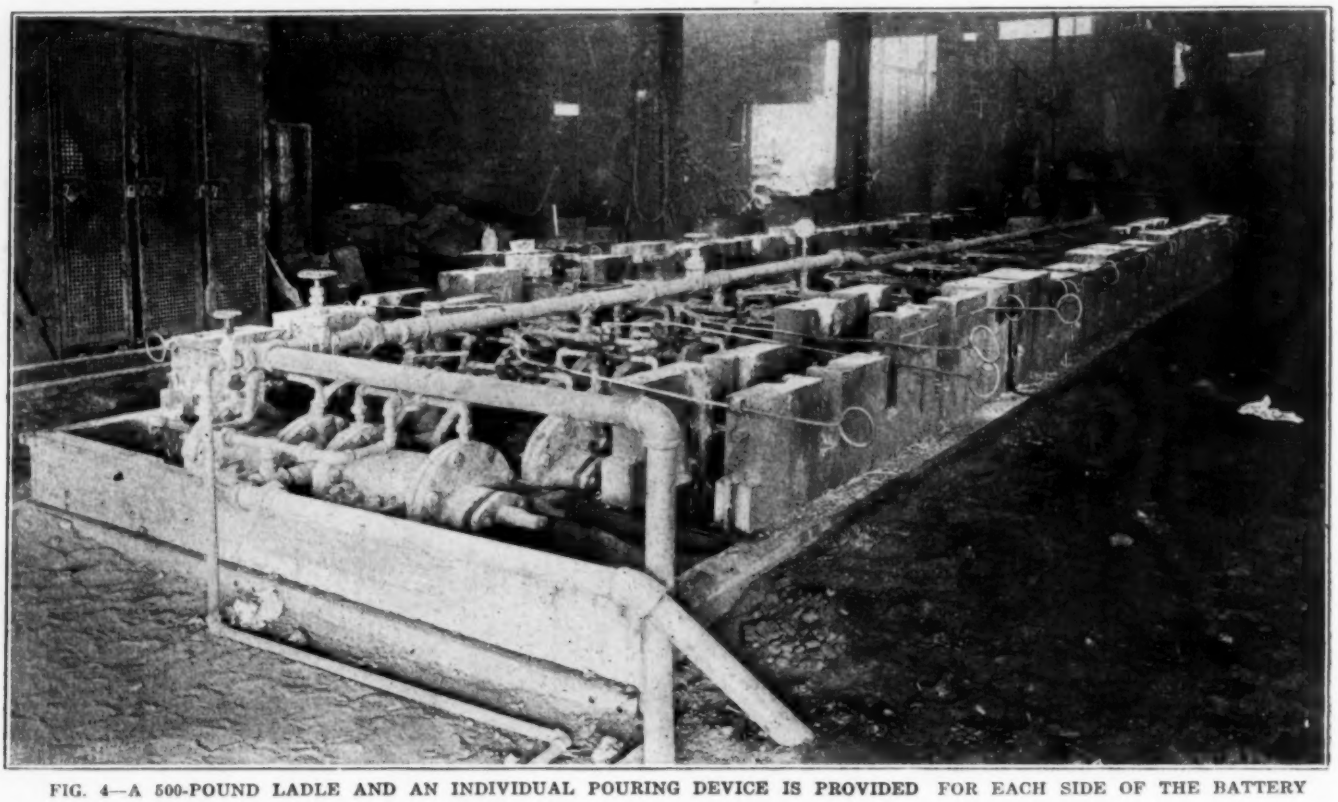


FIG. 4—A 500-POUND LADLE AND AN INDIVIDUAL POURING DEVICE IS PROVIDED FOR EACH SIDE OF THE BATTERY

Can Used Sand Be Reclaimed-IV

Foundrymen Crave Immediate Results in Determining Character of Sand Offered for Use—Orders Lose Force Through Indirect Delivery

By Pat Dwyer

IN THE discussion which followed the presentation of a committee report at one of the sand sessions of the recent convention of the American Foundrymen's association in Syracuse, the manager of a prominent steel foundry in the Middle West said something that appealed to many of those present and which represented perhaps in a greater degree the opinion of many who were not present. He said that while the various papers presented at the sessions indicated a vast amount of research and a capacity for infinite detail on the part of the authors, still he doubted if they were appreciated by foundrymen in general. They were of a highly technical character and apparently were written for the benefit of the men actually engaged in carrying on research work on sand. They presupposed on the part of the audience a chemical and engineering training and the possession of the necessary laboratory equipment to duplicate the work described in the papers.

Needless to say, the average foundryman from the molder to the manager does not qualify under the foregoing heading. An experienced molder does not need any mechanical equipment to decide for himself whether sand is suitable for his purpose. With his eye and hand he can form a fairly accurate estimate of the bond, the permeability and the grain size. He may not use these terms in his mental estimate, but the net result is the same as if he had used any of the regular apparatus provided in the laboratory for determining these factors. Of a sand that meets his approval he probably will say: That stuff will lift, it will vent all right and will leave a good skin on the casting.

He depends on a practical test for his final decision. He examines the castings made in the sand and that is all the evidence he requires to determine whether or not the sand is sufficiently refractory. If the face of the casting is smooth and clean he is satisfied with the sand. If the sand sticks to the face of the casting he knows that an excess of bonding element, which fuses easily, is present in proportion to the silica or quartz content. If the sand will not *hang together* after it has been used once or twice he knows it is deficient in this same bonding element.

While this form of knowledge is excellent in itself, it presents two serious drawbacks. In many of the largest foundries today molding machine operators are developed almost over night and naturally they have not that peculiar instinct or sixth sense for judging sand which is inherent in men who have been working many years at the trade and who have been accustomed to cutting their own sand heaps with a shovel. The modern molder does not mix his own sand, therefore he is not familiar with the feel of it. He does not pour his own metal, therefore he has no opportunity of observing how the metal behaves in the mold. In many instances he does not even see the castings he helped to produce and as a result he has no opportunity of comparing cause and effect. Clearly it is apparent that if the sand is to be prepared mechanically and distributed mechanically in large quantities, suitable mechanical testing and control methods must be observed to insure mechanical uniformity.

Molder is Handicapped

Consideration of the second drawback leads to the same conclusion. Even where a molder is perfectly qualified to pass on the quality of the sand, he is handicapped in his effort to pass the knowledge on to others. He knows that sand is tight or open, weak or strong and has a long or a short life, but he has no scale to indicate the maximum or minimum or the various grades in between.

What is wanted is some simple form of test from which any person of ordinary intelligence may draw definite conclusions. In the words of a foundryman from central New York:

"We are greatly interested in the subject of sand reclamation and would like to see some method of testing developed which is not so complicated and technical that the ordinary foundry foreman promoted from the floor is afraid to try it."

In the last analysis a foundry is a commercial or industrial establishment and not a laboratory or an experimental station. While certain members of the staff may have the true scientific mind for carrying on investigation merely for the sake of investigation, the manager of the plant usually has the more practical turn of mind. All he wants is results that will show as prominently as possible on the proper side of the ledger. This is illustrated by an incident in a southern foundry.

The true scientist confronted with the problem of removing the carbon deposit from the grains of core sand as a preliminary to using the sand over again, worked assiduously and eventually produced a mass of sand as white as the traditional driven snow. He had washed it and screened it and had boiled it for hours first in sulphuric acid and then in a caustic solution. So far as he was concerned the problem ended right there. He had been asked if old sand could be cleaned perfectly, and he had demonstrated that it could be done. The manager's problem was not solved or even half solved. The experiment in his eyes merely proved that the game was not worth the candle. He had no trouble in proving to himself that he could continue buying new sand at a price considerably lower than that in which it could be reclaimed by the process illustrated.

As a beginning toward standardization and therefore more economical operation, the manager previously referred to suggested that the committee decide in some manner the proper amount of new sand necessary to keep sand in workable condition. He was not interested in details or in methods. He claimed that surely with all the information at their disposal the members of the committee could lay down a definite ratio as being ideal. With something of that kind in sight foundrymen would have a definite mark at which to shoot. He was of the opinion that the ratio could be drawn between the weight of the metal melted and the sand used during a given period, say a month.

With few exceptions foundrymen draw no comparison between these two items although they are so closely related. A manager does not want to skimp on his new sand, that is he does not want to skimp to a point where casting losses can be attributed directly to the quality of the sand. At the same time he cannot see the necessity, for example, of using new sand exclusively in all the facing. To find the happy medium is a

problem that presents many angles to the thoughtful manager who wants to build on a permanent foundation. Sudden introduction of any drastic change usually proves expensive. If the change should prove effective later, the saving will absorb the initial expense, but if, as sometimes happens, the new idea, method process or material does not measure up to anticipation then there is another story to tell. The foundry reverts to its former condition, the wise ones nod their heads and say *I told you so*, and the man responsible for the change either swallows his pride and says nothing or he joins that class referred to in theatrical circles as being at liberty.

The average man in authority takes too much for granted. Naturally it is a physical and mental impossibility to attend to every detail and he has to depend on assistants. Frequently the assistants in turn have other assistants and as a result few messages pass either up or down the line without more or less tinkering. Notable exceptions to this general rule immediately will come to mind, but in the main it is true.

For example in a "No Smoking Allowed" shop the general manager unexpectedly catches a glimpse of old Jerry the carpenter enjoying a few stolen puffs while repairing a flask in the yard. Such a wanton disregard of general orders cannot be overlooked. On his way back to the office he meets the superintendent and tells him to fire old Jerry. The superintendent meets his foreman later in the day and speaks to him severely about enforcing the rule against smoking. He tells the foreman to lay old Jerry off for a week just for an example.

They Pass the Buck

The foreman expostulates warmly that Jerry is an old and respected employe, a clever workman and one who will be hard to replace satisfactorily. Still later in the day he trims the hide off Jerry, figuratively speaking, not for smoking, but for getting caught at it. He tells Jerry he has had positive orders from headquarters to fire him if he catches him at it again. Thus the scorching blast of dismissal red hot leaving the front office becomes nothing more than a fairly warm breeze by the time it arrives at its destination.

General orders from headquarters regarding sand consumption sometimes are defeated in the same manner, not by active, but by a species of passive resistance. Even the dullest machine operator knows that new sand is added to the heap to revive it, make it strong and thus insure better lifts and draws. If left to his own devices he will add a great deal more new sand than is required and then if an investigation is held he will claim stoutly that he only used the scant minimum allowed him according to regulations duly promulgated and pasted up at various points in the foundry.

This necessity of passing orders through so many stages is responsible for the difficulty of making shop practice coincide with laboratory experiment. Based on a careful series of experiments the chemist or foundryman may decide that new sand in the proportion of 10 per cent of the weight of the castings produced should be sufficient to keep his sand in good working order. A general order is issued to this effect and the natural assumption is that it will be carried out. In some places it is carried out literally, or at least to an extent that is close enough for all practical purposes, but in the great majority of cases the supply of new sand remaining at the end of any given period bears little resemblance to the amount that confidently was anticipated when the new rule went into effect. The remainder simply has disappeared, vanished without a trace and simply constitutes another one of these mysteries of the foundry that cause the bookkeeper's hair to turn gray prematurely.

Co-operation Required

Co-operation of the closest kind is needed not only between the various members of the technical and executive staff, but also between these men and the operators who actually prepare the sand and make the molds. Definite results only can be attained where the spirit of co-operation and close control exists. An extreme example showing how new sand was absorbed by one gray iron foundry at an alarming rate for several years before an investigation was ordered presents some unusual features.

The particular foundry was one of a group operated in various parts of the country by a single company. The superintendent in each plant had full control of every feature including the ordering of supplies and reported only to the operating vice president of the company who had an office at the parent plant which also was the largest of the group.

With a thousand pressing matters to engage his attention every day the discrepancy in the reports dealing with new sand consumed in the various plants conveyed no particular significance to the vice president's mind for some time. However, when his eye finally lighted on this leak down which expense money was pouring like water down a rate hole, he called every superintendent in from the outside plants and had a show down.

He believed in bluff, direct-to-the-point methods and therefore lost no time in telling these men that the records of sand consumption showed too wide a spread. The best report indicated that 1 ton of new sand was added to the heaps for every 5 tons of castings produced. The worst report, and the one that created the most astonishment, showed that over a ton of new sand was used in the production of each ton of castings.

Sold Sand To Himself

The V. P. was not a foundryman and therefore was in no position to instruct the extravagant man how to improve his practice. However, he was in a position where a few potent words had more effect than a book full of technical instruction. He told the sand waster that unless he kept inside a 1 to 5 ratio the same as the high liner of the group, he would be glad to consider his resignation at any time. He said that what was past, was past and he neither knew nor cared what factors were responsible for such an extraordinary condition, but there was going to be some toeing the mark in future. He asked no embarrassing questions and he made no insinuations and he listened courteously to the explanations advanced by each member of the group. He admitted that faulty practice in the past might have been responsible, but now that every member of the group had learned what the others were doing, this excuse no longer existed.

Sand consumption in the various shops never became exactly alike, but the figures on the various reports submitted afterward were sufficiently close to a common standard to satisfy the vice president's sense of economy and propriety. Through one of the numerous channels by which vice presidents and other executive officers receive information, official and unofficial, the cause of the immense new sand consumption in the shop under discussion came to this particular vice president's attention. He learned that the foundry superintendent was the *Co.* in a company which supplied the foundry with sand.

A tabulated list of the practice in 30 foundries selected at random from the stack of answers elicited by the questionnaire was presented in the second article in this series published in

THE FOUNDRY, March 15. This tabulation showed the amount of sand used in a year compared with the tonnage of metal melted in the same period. By far the greater number of replies deal with gray iron foundries, but this is quite consistent since gray iron foundries still constitute the overwhelming majority of the casting plants. However, the other branches are not neglected. Typical reports indicate what is going on in malleable, steel and nonferrous foundries.

Even where allowance is made for the variation in product and the consequent degree of severity to which the sand is subjected, the indicated variation in the amount of new sand is rather startling. It ranges all the way from pound for pound up to 43 pounds of casting for each pound of new sand. This last figure is extraordinary and was submitted by a nonferrous foundry pouring 10 tons a day, approximately 3000 tons a year on a total new sand consumption of 70 tons.

Wide Variation

The heaviest consumption of new sand naturally is in the steel foundry. This is due to two conditions. Almost twice as much metal is melted and poured into molds as is shipped in the form of finished castings. Thus while a comparison of sand against metal melted might work out as 1 to 2, the same amount of sand taken in comparison with the castings actually shipped conceivably might not show a better ratio than 1 to 1. The second condition, of course is the abnormally high temperature at which steel is poured and the comparatively large amount of facing sand that is actually destroyed from contact with the metal.

In the three examples of steel foundries shown in the table it will be noted that each one presents a different amount of sand in proportion to the amount of metal melted. The first claims to have used 4800 tons of sand for 6000 tons of steel. The second melted 45,000 tons of steel and used 24,000 tons of new sand while the third used 40,000 tons of new sand and melted 60,000 tons of steel. In percentages the relative amount of sand to steel is respectively 1.25, 1.84 and 1.50 for the first, second and third case cited. Considering the subject from another angle and taking an arbitrary 50 per cent of the metal melted to represent the finished castings, it is apparent that in the first case only 1200 pounds of castings were realized fro meach ton of sand. The second case shows a ratio of 1800 pounds of castings for each ton of sand. The third item indicates that one ton of sand was consumed for every 1500 pounds of castings produced.

Ratio In Gray Iron

In the gray iron foundries the proportion of new sand to metal melted ranges from 1 to 3 up to 1 to 15. However, the majority of the reports were laid between much narrower limits and showed that the average practice in American foundries favors a use of 1 ton of sand for every 7 tons of casting poured.

Two nonferrous reports appear in the table and they differ widely from the report quoted elsewhere. The first is that of a small shop where 5 tons of new sand are used in a year and where 15 tons of metal are melted in the same period of time. This is a proportion of 1 to 3 and does not differ widely from the second report which is from a fairly large nonferrous foundry. Here 22,500 tons of metal are melted in a year on a consumption of 5000 tons of new sand, a proportion of 1 to 4.5.

Considerable variation may be noted in the report covering the new sand consumption of malleable foundries. Only five out of the total number are set down in the table, but of these five, one shows a ratio of 1 to 8, another 1 to 15, a third 1 to 7 and the fourth 1 to 10. The fifth, which by the way is one of the largest in the country equipped as it is with eight 25-ton furnaces, used no new sand during the past year. A special grade of fire clay was employed to renew the bond in the burned sand and incidentally maintain the volume that constantly tends toward depletion from the sand that adheres to the castings and is carried away from the molding floors. More extended reference to this style of rejuvenating sand will be made in a later number of this series.

This is the fourth of six articles by Mr. Dwyer on the general sand situation in the foundry. The fifth takes up further features covered by the questionnaire, relative proportion of foundries in which sand control is exercised and the manner in which the new sand is added. It will appear in an early issue. The Editors.

Committee Meetings Are Held in East

Committees of the American Society for Testing Materials held their fifth group meeting at Providence, R. I., March 15 to 19. The meetings of the various committees were attended by about 350 members and guests representing the industries, such as, the producers of iron and steel, nonferrous metals, representatives of the railroads, etc., which are concerned with the work being carried on by the society. Thirteen committees, including A-1 on steel, A-2 on wrought iron, A-5 on corrosion and B-2 on nonferrous metals and alloys, participated in the meetings.

Several interesting reports were received by committee A-1 on steel, and certain recommendations were made. This committee recommends, subject to approval by letter ballot, that the specifications for carbon tool steel and for high speed tool steel, be adopted as standards. Minor modifications were proposed in the specification for carbon steel castings for valves, flanges and fittings for high temperature service. It was decided to continue this specification as tentative for another year.

The joint research committee on the effect of temperature on the properties of metals, has heat treated and distributed one class of steel to the four co-operating laboratories for testing. The results of inspections of the test sheets exposed at Fort Sheridan, Ill., were reported to committee A-5 on corrosion. Further failures of the materials were recorded. Co-operative tests have been instituted with Lloyd's register of shipping on the corrosion of certain classes of steel. A summary of results obtained so far on the total immersion tests at Annapolis, Washington and Key West was presented. These tests when completed will give data on the serviceability of iron and steel in different waters, and also afford a comparison with the atmospheric exposure tests now being carried on. This committee is closely co-ordinating with that on zinc coating of iron and steel. Specifications and testing methods for zinc coating will be formulated by these committees.

Nonferrous metals and alloys under the supervision of committee B-2, received attention. Five new specifications were presented and accepted for submission to the society at the next annual meeting. These include the specifications for aluminum bronze castings, steam or valve bronze, brass or ounce metal, alloy 88-8-4 and for aluminum base alloy for sand castings. The committee expects to present with its report at the annual meeting in June, a paper on light aluminum casting alloys. This will be a companion paper to that presented two years ago on high strength light alloys.

Harlan A. Pratt has been appointed manager of the oil and gas engine department of the Ingersoll-Rand Co., New York.

PROGRESS SHOWN

Review of the First Quarter Century Just Closed Gives in Perspective the Long Strides Made in Foundry Construction, Equipment and Character of Product. Steel and Malleable Castings Rank High

By Dan M. Avey

"Shall not the next 25 years see similar wiping out of hundreds of small foundries with their cupolas, which now encumber the ground?"

THIS statement credited to a writer in *Engineering and Mining Journal* appeared in the first few months of the present century and aroused caustic comment from prominent foundrymen of that period. The writer's remarks were made in commenting upon the lack of initiative which led foundrymen to remelt all their metal, instead of establishing their shops alongside blast furnaces where hot metal could be used to pour castings direct. The same attractive idea occurs periodically. It has been tried by many independent investigators, not excepting an automobile manufacturer credited with quite a little acumen, who thought he had found an elemental fact overlooked by everyone else in the foundry industry.

Cupola Still Supreme

To the confusion of all these expert observers and occasional prophets from without the industry, the foundry cupola with a few minor modifications from time to time, continues to perform its appointed task, melting iron most economically for certain classes of castings. Hundreds of gray iron foundries may have passed out of the picture, but not for the reasons stated by this prophet of 1900. In the meantime, hundreds of others have taken their places, larger shops are in existence today and the practice of castings manufacture has kept pace with every other industrial development of the first quarter of the twentieth century.

To an observer within the industry, one actively interested in castings manufacture only in recent years, the progress which has been made cannot be fully appreciated. If such a one could be translated back to the days of 1900 and placed in an up-to-date foundry of the period, a plant which embodied the last word in every phase of management, construction and method of operation, the marked change from that day to this would be so apparent as to warrant the use of the term, revolutionary.

The very type of foundry building was radically different the early part of this century. True, brick construction predominated then as now, but the wide pilasters, comparatively narrow window space, the framed wood or steel roof trusses and the absence of roof sash, now so essential to good lighting and proper ventilation, made the shops of that day dingy, smoky and disagreeable to the workmen therein employed.

Cranes were necessary in heavy work foundries, but they were mainly of the most elemental form. Jib type cranes, mounted on inner columns or upon the outer walls were hand operated or actuated by hydraulic power. The electric crane, so essential today was a novelty in the early part of the present century. Warm arguments occurred in the meetings of foundrymen, as to whether electric cranes could be stopped when set in motion. One prominent foundryman went so far as to advocate leaving all brakes off such cranes for fear of what might happen to motors, driving mechanism and girders if someone applied the brake injudiciously.

Molders of 25 years ago must have possessed the eyesight of cats or the groping sense of moles judging from the character of their work and understanding as we do the inadequate lighting of the shops of that day. A few drop cord electric lights were used, but gas and acetylene flares were in common use to supplement the feeble light which filtered through scanty panes of dirty glass in the limited window areas.

Machines Were Crude

Although molding machines had been invented and patents were granted on crude models as early as 1852 and a stripping plate machine for making pipe was announced in England early in the nineteenth century, the use of such machines was extremely limited in 1900. Those which were available were plain machines upon which the flasks were placed and the sand was rammed by hand. Some of them had a mechanism for withdrawing the pattern through a stripping plate, and only one type of squeezer machine was mentioned in then current foundry literature.

A few types of sand preparation equipment were available. A revolving, belt-driven, octagonal riddle, forefather of the multiplicity of power driven sieves, riddles and screens of today was the first emancipator offered molders from the backbreaking drudgery of the hand riddle. The early sand mixers were modified forms of the dough mixers used by bakers and probably the first type of sand preparation unit was made by a company which specialized in baking machinery. One centrifugal sand aerator was available.

The first types of pneumatic chipping chisels were offered early in the present century. The first heavy, cumbersome, pneumatic rammer in use in those days resembles but little the light efficient tools in service today. Sandblast machinery was simple and crude as compared to the present types of complete units. The sandblast of 1900 was little more than a tank, with air pressure connections through which sand and air were driven through a hose to a nozzle with an action similar to that of an atomizer. The revolving tables, enclosed sand-blast rooms, elaborate reclaiming and dust removal accessories and the combined tumbling-barrel, sandblast machine were entirely unknown 25 years ago.

Briefly stated, the greatest strides in foundry practice during the first quarter century have been in mechanical equipment. Heavy hand labor performed practically all operations in 1900, while today mechanical aids have speeded up and rendered more efficient every step in castings manufacture Practically every modern foundry has at its

command and uses machinery for handling its sand and metal; for sifting, mixing and blending its sand for molding; for making its molds, lifting and shifting heavy flasks and equipment; for charging its furnaces, handling and pouring its molten metal; for removing its castings and wasting or reclaiming sand; for cleaning, handling and loading its castings for shipment. These operations with few exceptions were performed by manual labor in the early nineteen hundreds.

Quality Greatly Improved

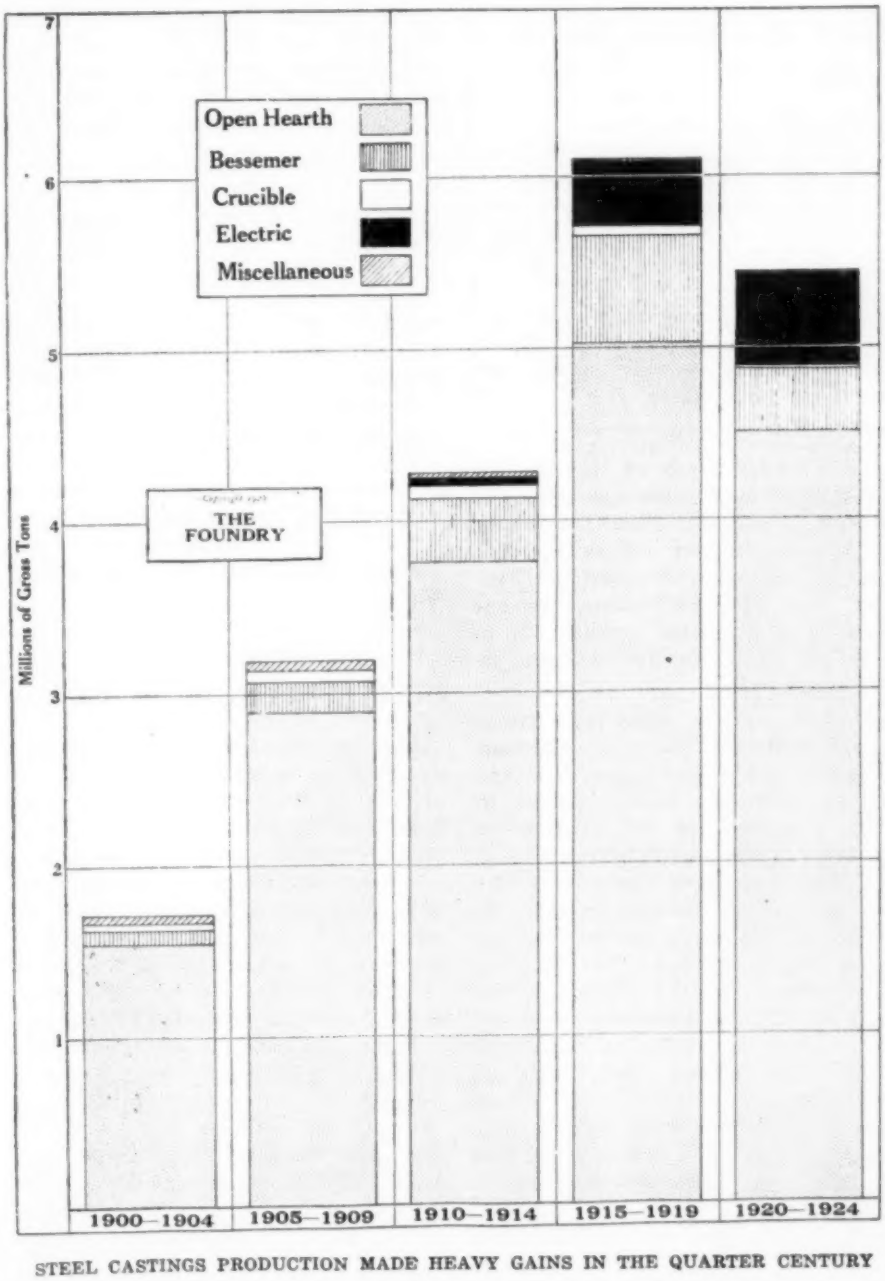
The past 25 years have seen even more remarkable developments in metallurgy and in the quality of castings made available for industrial service. Scientific advance has been made in practically every branch of the foundry industry, whether ferrous or nonferrous metals are used. The period in question has seen advances in gray iron, the pioneer metal from which castings always have been made for a wide range of industrial uses. The mixing of iron by analysis, instead of by rule-of-thumb, the production of special grades of iron ranging from the glass hard, high silicons found in acid resisting castings to the machineable, tough product secured by alloying, have marked the past 25 years as noteworthy in gray iron foundry practice. Wide use of steel scrap melted with iron in the cupola has given a high quality metal unknown in 1900.

Table I

Total Pig Iron and Foundry Iron Produced

1900-1925

Year	Total pig iron	Foundry iron	Percentage foundry to total	Year	Total pig iron	Foundry iron	Percentage foundry to total
1900	13,789,242	3,376,445	24.4	1913	30,966,152	5,220,343	16.9
1901	15,878,354	3,548,718	22.2	1914	23,332,244	4,533,254	19.4
1902	17,821,307	3,851,276	21.6	1915	29,916,213	4,843,899	16.2
1903	18,009,252	4,409,023	24.5	1916	39,434,797	5,553,644	14.1
1904	16,497,033	3,827,229	23.2	1917	38,621,216	5,328,258	13.8
1905	22,992,380	4,758,038	20.8	1918	39,054,644	5,145,260	13.1
1906	25,307,191	4,773,011	18.6	1919	31,015,364	4,916,758	15.8
1907	25,781,361	5,151,209	20.0	1920	36,925,987	5,957,782	16.1
1908	15,936,018	3,637,622	22.8	1921	16,688,126	2,568,136	15.4
1909	25,795,471	5,322,415	20.8	1922	27,219,904	3,976,431	14.5
1910	27,303,567	5,260,447	19.3	1923	40,361,146	6,470,013	16.0
1911	23,649,547	4,468,940	18.9	1924	31,405,790	5,623,124	17.9
1912	29,726,937	5,073,873	17.1	1925	36,700,566	5,410,217	14.7



STEEL CASTINGS PRODUCTION MADE HEAVY GAINS IN THE QUARTER CENTURY

Statistics Meagre

No production figures are available upon which to base a comparison of the total tonnage of iron castings made through the various years under consideration. An approximation might be offered from the total production of foundry iron made by blast furnaces throughout the country in these years. However, it must be remembered that these production statistics do not take into account the large amount of cast iron and steel scrap which has gone through the cupolas of America's foundries in the period in question, nor the total tonnage in stock in foundry yards, nor the various other grades such as malleable, which are being used in larger proportions in gray iron mixtures.

The production of foundry iron, the total output of pig iron and the percentage of the total production represented in foundry grades from 1900 to 1925 are given in Table I accompanying. It will be observed that the ratio of foundry iron to the total production of all classes of pig iron has been declining. Of course the output of iron has mounted to a surprising degree during the past 25 years, so that it is probable that more gray iron castings are produced today than ever before, but the consuming capacity of the coun-

try is larger and other kinds of castings, rolled and other fabricated products probably have advanced and taken a share of the business.

A closer study of steel castings is possible through statistics compiled by the American Iron and Steel institute. These show the remarkable development of the steel castings industry from a total tonnage of 192,808 in 1900, through the peak output of 1,458,031 tons in 1923 with an average of well above a million tons a year. This period has seen crucible steel castings start at around 4000 tons annually, rise to a record of over 20,000 tons and then decline to about 1000 tons per year.

Electric furnaces have been invented and perfected in this period. Although the first electric furnace was put into operation in this country in 1906, it was not until 1909 that the output of steel castings from this melting unit reached the dignity of representation, with an annual tonnage of 306. The growth in favor was gradual, until 1923 established a record of 235,958 tons.

Bessemer converters grew steadily in the regard of foundrymen until a production of 160,844 tons in 1918 set the high mark. Since that time a decrease in production of this class is noted, but for certain kinds of work, this type of melting unit probably will maintain its position.

The open-hearth furnace has been the largest single factor in steel castings production. The graph on page 783 visualizes the growth of steel castings production through the first 25 years of the century. Totals of the tonnages produced by the different processes have been plotted, arranged in periods of five years each. From 1915 to 1919 covers the time when America was bending every effort to produce war materials and when steel castings were in urgent demand. The five years from 1920 to 1924, inclusive, marks the post-war expansion and the return to normal conditions.

Malleable iron castings have experienced many vicissitudes during the period from 1900 to the present. Malleable foundry practice at the start of this period was shrouded in secrecy and each maker of malleable regarded his method as a proprietary process to be guarded from the world. In 1903, H. E. Diller, late metallurgical editor of *The Foundry*, and an authority on malleable, described the methods and products of malleable foundries of that day. He reported that 40,000 pounds tensile strength was perhaps the highest obtainable, although a slight increase over this figure might be attained with care. Losses ranged from 10 to 20 per cent and in most cases probably were closer to the latter figure. However, he saw a brighter future for this class of castings, remarking prophetically, "yet as specifications become more severe, general quality will be improved until we get a more reliable article."

This is exactly what has transpired. Malleable castings manufacturers diagnosed their own ills, prescribed their own treatment and by a rigid system of self-imposed inspection, coupled with an interchange of ideas, they have produced a uniformly reliable product widely favored for railway, automotive and other severe services. The standard specifications of the American Society for Testing Materials, today call for a tensile strength of 50,000 pounds per square inch, with an elongation of 10 per cent. Where only 95 foundries were making malleable iron in 1900, probably 250 now are producing dependable castings.

Nonferrous foundries have increased both in numbers and in the total productive capacity during the past 25 years. No statistics are available which will give the latter, but the listing of plants compiled each two years and published in *Penton's Foundry List* shows the latter to be true. The total number of foundries in the United States and Canada are given in the accompanying Table II. A tendency of the past few years has been to larger plants, making specialties on a production basis. Automotive demand also has led to the construction of nonferrous casting plants of greater capacity.

Melting units employed by brass foundries have undergone a number of important changes during the first quarter century. The pit-type, crucible furnace still is employed to a great extent, but coal and coke have been displaced by oil and gas as fuel. Many new types of crucible and noncrucible furnaces for melting brass and aluminum have been developed and these have been supplemented in the larger production shops by various types of direct arc, resistance and induction furnaces.

Local demand, the ready availability of scrap metals and the low investment required for machinery and equipment in brass foundries all combine to attract men and firms of limited financial means into brass castings manufacture. The demand for nonferrous castings has been growing steadily. Plumbing goods, hardware, art castings, automotive, bearing, valve and fitting and miscellaneous demand based upon considerations of corrosion resistance continue to grow and expand the services for which the products of nonferrous foundries alone can supply the need.

Table II

Total Number of Foundries in United States and Canada

(From Penton's Foundry List)

Year	Total No. foundries	Total No. gray iron foundries	Total No. malleable foundries	Total No. steel foundries	Total No. nonferrous foundries
1900	6017	.....	95	51	.....
1902	5116	.....	102	72	.....
1906	6108	4956	126	156	2432
1908	6366	5106	158	211	2799
1910	6594	5157	178	265	3558
1912	6538	4943	190	318	3680
1914	6507	5057	214	318	3832
1916	6290	4724	218	332	3447
1918	6444	4787	268	426	3472
1920	6516	4857	267	449	3482
1922	6733	4854	274	409	3542
1924	6475	4564	229	374	3574

Scrap Business Is Large

Last year 11,000,000 tons of iron and steel scrap passed into the maws of the openhearths, the blast furnaces and the iron and steel foundries of the country. Of this total 4,000,000 tons were furnished by the steel mills and foundries themselves. In other words, they charged back into the furnaces and cupolas 4,000,000 tons of scrap they themselves made. That leaves 7,000,000 tons which passed through the markets. Granting this scrap averaged $15 a ton, that makes $105,000,000 of scrap that went through the markets last year. To this add between $800,000,000 and $850,000,000 worth of nonferrous scrap that was salvaged and put back into usefulness by remelting.

Pours Work in Casting Machine

Plow Points, Barrel Rims, Journal Brasses, Etc., Made in Device First Exhibited in Chicago in 1913

By W. W. McCarter

IN 1883 I was working for 25 cents a day, making a salary of $1.50 a week, provided we worked six days a week as long as daylight lasted and then took off the heat at dark. A molder ready with a ladle of iron for pouring his work shouted, "Skim! Hold up! Show the gate! Fire the vents! Stop in! Short! More iron!!!" I could not do all of these things and keep up with the rapid fire staccato commands, but I responded to the first command given by grabbing a long clamp and *just starting to skim.* That is as far as I or anyone else ever went with a clamp or a pipe for a skimmer. I learned from that experience just what everyone else learned when trying to skim a ladle of iron with a clamp.

I learned the same as a molder in the same shop who tried to cast a knob on the end of a pipe, as shown in Fig. 2. I learned that a cold surface of metal coming in contact with molten metal suddenly produces results of an explosive nature. Unless the condensed water vapor of the atmosphere on the surface above the molten metal is given time to evaporate, the sudden expansion of steam causes bad behavior on the part of the molten metal as it comes up against the water. We called it sweat in those days. Today we refer to it as *sweat*, and it has made no change in its behavior under similar conditions.

In 1890 the Kennesaw Marble Works, Marietta, Ga., placed an order with the Glover Machine Works, that city, for a number of chilled balls, called rollway balls or friction balls which were 6 inches in diameter. These balls were used to move large tonnage blocks of marble. A heavy chill was cast as shown in Figs. 3 and 4 to make this work. The machinist foreman and the superintendent, who worked as a boy in a machine shop with foundry in connection and in the course of his apprenticeship also worked in the foundry, directed that the chill balls be cast as shown in Fig. 3.

I had not forgotten the clamp incident which happened 7 years before, nor the attempt at casting a knob on the end of a pipe with that little formality of plugging the pipe neglected. I never yet have thought that the failure to plug or cap the pipe was intentionally perpetuated, nor do I believe it an oversight. Ignorance is the only cause to which such hazardous blunders may be attributed. I believed that way in those days, after it all happened. With my former experience and the vivid recollection of the animated shop crew in spectacular performance, I, with a bar of soap and a towel, issued an ultimatum when it was expected that I would pour metal into the combination air compressor and gas expander as illustrated in Fig. 3. After some discussion it was agreed that the experience of the machine man could not be depended on in matters where only foundry experience was needed. It was understood clearly, that all the foundryman does anyway, is to deliver the goods.

With the matter of who was boss of the foundry settled, even though I previously had been hired for that purpose, the chill was not rammed up as shown, but only was discussed. The matter of the height of the pouring gate also was discussed and the idea of increasing its height was suggested, as shown in the illustration, where a deep drag and two shallow drags were to be employed. All of this is

Applies Principles Learned as an Apprentice

MANY years ago, Mr. McCarter, who now is instructor in mechanical engineering, foundry department, Agricultural and Mechanical College of Texas, College Station, Texas, was a regular contributor to THE FOUNDRY. *However, as he expresses it, recently he has procrastinated in his writing due to being busily engaged in making ferrous and nonferrous castings in a device, which first was exhibited at the Chicago convention of the American Foundrymen's association in* 1913 *and was styled a casting machine.*

In this article, Mr. McCarter has given the history of a casting machine of his design. He has gone back to his early days in the foundry, and told of some of the incidents which brought basic principles to his attention. These principles later were remembered and applied in the operation of the casting machine which has been used to make a variety of castings of ferrous and nonferrous metals.—The Editors.

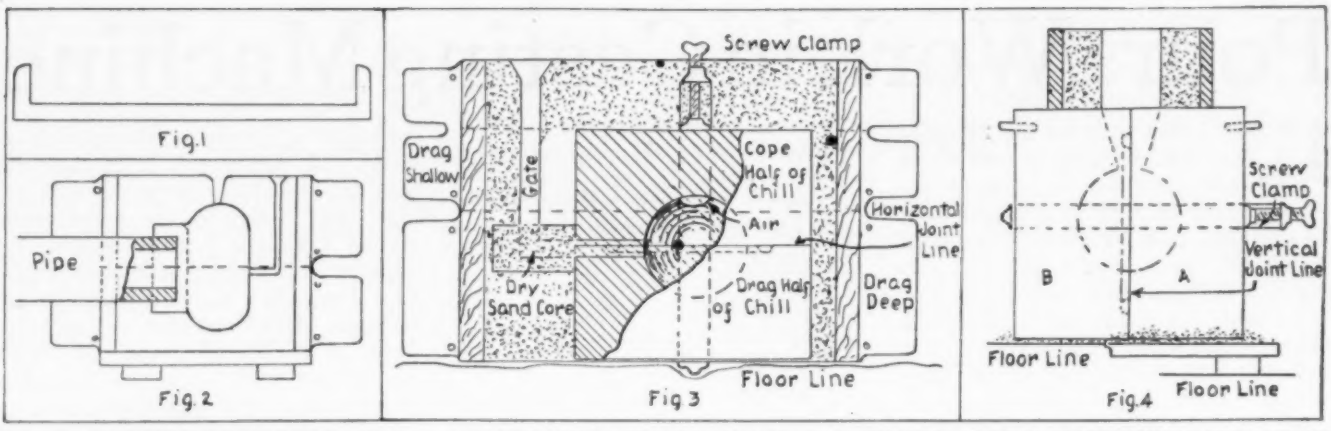


FIG. 1—THE SKIMMER EMPLOYED. FIG. 2—A COMBINATION WATER VAPOR COMPRESSOR, WATER CONDENSOR AND STEAM GENERATOR CAPABLE OF EXPLOSIVE VIOLENCE. FIG. 3—MACHINIST'S IDEA OF CASTING CHILLED BALLS. FIG. 4—METHOD LATER USED. THE BOTTOM BOARD WAS ELIMINATED AFTER THE FIRST CASTING WAS MADE

what brought about the soap and towel ultimatum.

I secured an obsolete bottom board and made a bed of sand upon it. A screw clamp on either side clamped the chill, which was caught up by the crane chained over four rods, two of which are shown in Fig. 4. The rods entered holes drilled, in this case, as in large blocks of marble for handling in a similar manner. After casting several balls, it was discovered that the bottom board was only a nuisance and it was abandoned. A bed of sand on the floor line, was not necessary, but we did not know all about that until it was tried.

With the chill installed vertically, referring to the joint line, the innocent looking substitute for active nitroglyerine shown in Fig. 3, was shorn of its strength like Samson of old, who was shorn of his at the hand of beautiful Delilah, who introduced, somewhat prematurely, present popular styles in hair cutting. However that too was another thing of which we were not altogether certain, and like the proverbial fellow from Missouri, we were ready to be shown, but who was brave enough to show us.

As there already was a molder in the shop who had lost one eye some time before in another foundry, it was up to me to do the pouring. This required that the pouring be done with

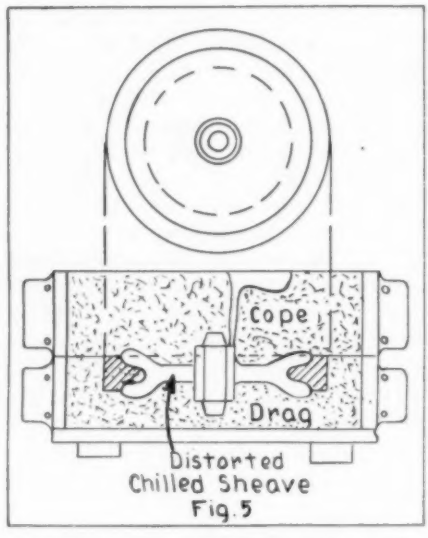


FIG. 5—MAKING CHILLED SHEAVE. THE ALARM CLOCK ALWAYS WAS TARDY WITH ITS WARNING

a hand ladle of insufficient capacity to bring up the metal. For that reason, I had another hand ladle caught full and stationed near.

The curtain was about to rise on the great event—and it did. I started dribbling the metal in cautiously with all springs set to join the others on the outside at the first indication of the metal spitting. However it did not spit. I then brought up the riser with the second ladle. The victory was won, in so far as pouring was concerned, but after all it was castings that were wanted. They were wrinkled and cold short, but solid. They would not do. Nevertheless the cold clamp idea associated with the slowly poured chill suggested the disappearance of the sweat.

With quick movement the two screw clamps were returned to the chill. The stampede tendencies of the shop crew had vanished. A hundred pound ladle was manned as usual and the chill was poured again down the riser. The air was driven out as the metal rose. The mysteries of the permanent mold had no further secrets to reveal. However, I did not know it was a permanent mold. The clamp of 43 years and the chill of 36 years ago have not been forgotten.

Fig. 5 represents a sheave where metal cores were employed. The metal cores were used because th spcifications called for a chilled sheave. We made a large number of these castings, until we learned how to pour them so that the moisture was allowed to evaporate from the under side, where it condensed. We often experienced the alarm clock effect which always occurred too late to be effective in saving the casting. The alarm always gave notice that pouring should cease. This would diminish the weight of scrap in that particular mold.

The foregoing preamble clothed in

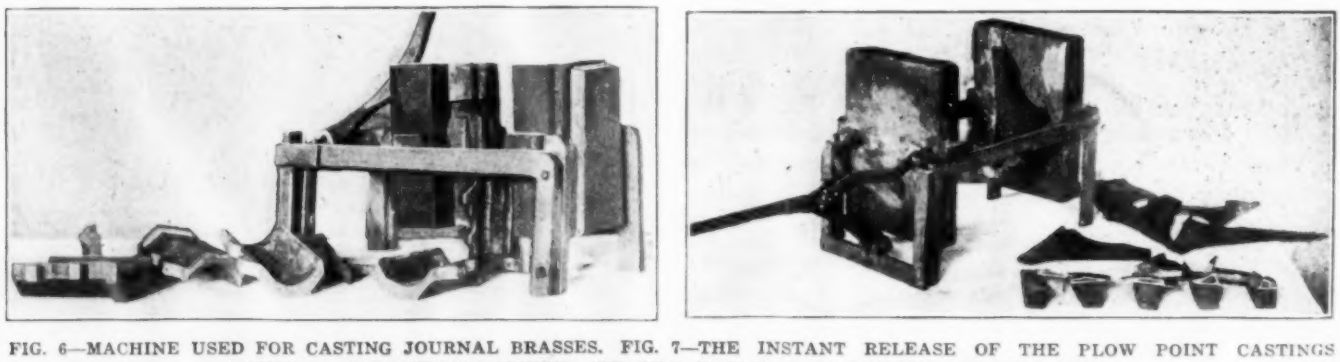


FIG. 6—MACHINE USED FOR CASTING JOURNAL BRASSES. FIG. 7—THE INSTANT RELEASE OF THE PLOW POINT CASTINGS PREVENTS HOT CRACKS WHICH ARE NOT UNUSUAL IN CASTINGS OF THIS TYPE

Fig. 8—Two Turpentine Dip Barrel Rims Were Made per Minute. The Casting Was Released at the Instant of Solidification by a Toggle Joint. The Instantaneous Release Allows for the Shrinkage of the Casting. Fig. 9—Machine for Making the Rims

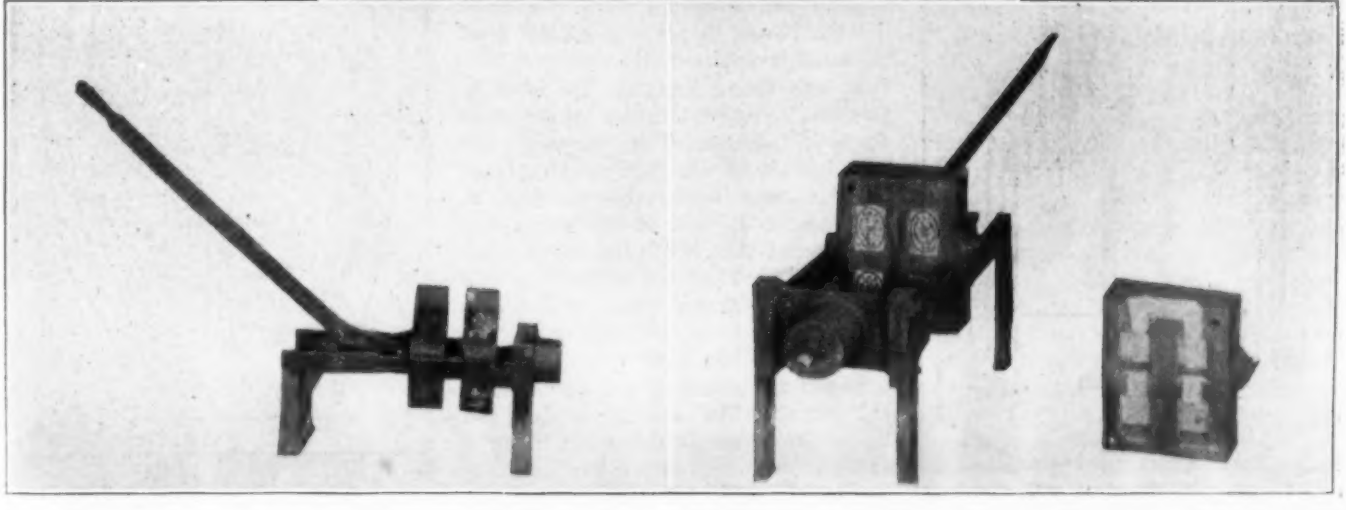
the garb of a joker does not lend jest to the facts so clearly brought out in Figs. 1, 2, 3, 4, and 5. All foundrymen are not chemists, but all foundrymen, of experience, know how to interpret *sweat*. The atmosphere we breathe consists of nitrogen, oxygen, carbon dioxide and water vapor, with which is associated a group of inert gases. A portion of this formula is contained in a chemistry I used 35 or 40 years ago. Another chemistry issued at a later date states that the components of air may be divided conveniently into regular components and accidental components: There are three regular components which are present in practically the same proportions at all times, and three, namely, water, carbon dioxide and dust which vary in quantity. The three compounds whose proportions do not vary are nitrogen, oxygen and argon and the inert gases except argon are present in traces only.

To the foundryman the elements of the air are the same everywhere and have not varied within historic times. In polar regions and the torrid zone alike moisture in the air will condense on cold surfaces exposed to molten metal and form steam, the volume of which is about 1650 times that of water from which it is formed. For that reason foundrymen never have been successful in pouring metal into chills whose jointline describes a horizontal plane. However, that is not the only reason according to the theorist on the outside, The theory of the man on the street is that two bodies cannot occupy the same space at the same time. This logically would appear to apply in the foundry generally, but in particular that universal law does not occupy such a broad scope as may be imagined with reference to air and metal as noted in Fig. 3. That universal law would apply were it not repelled by the Sherlock Holmes intuition so clearly explained in eagle eye watchfulness as in Fig. 2. For these two reasons I adapted the vertical joint installation as shown in the reproduction of the photograph of the original machine. The queer looking device was styled a casting machine, of which the foundrymen of that day were so skeptical. The foundrymen of the old school, who were in attendance at the American Foundrymen's association exhibit in the Armory on South Halsted street in Chicago in 1913, remember having signed my register, a part of which I have at the present time. The casting machine is here to stay.

E. O. Shreve, manager of the San Francisco office of the General Electric Co., has been appointed manager of the industrial department of the company with headquarters at Schenectady.

Fig. 10—Souvenirs Made from Nonferrous Metals in the Casting Machine.

Figs. 11 and 12—Side and End View of Casting Machine



Melts Metal in High Frequency Induction Furnace

By Dudley Willcox

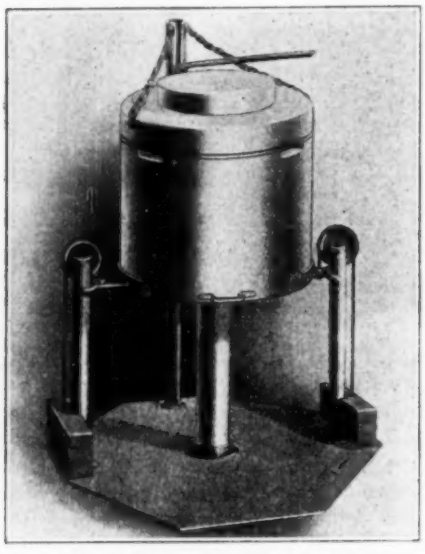


Fig. 1—Furnace in Melting Position

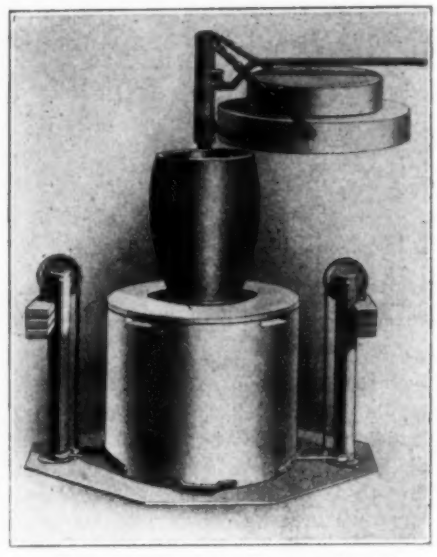


Fig. 2—Lowered To Remove Crucible

THE high frequency induction furnace described in this article was developed in an effort to make a brass melting furnace with the following characteristics:

The shape of the metal bath to approach that of a cylinder whose height is equal to its diameter, because this shape has small radiating surface per unit volume.

Little or no waste space remaining above the melt.

Aperture for charging to be large and easily accessible.

Pouring spout arranged so that molds may be poured from the furnace if desired.

Heat to be generated uniformly throughout the mass to be melted.

Thorough mixing of alloys without use of stirring rod or any motion of furnace.

Minimum refractory material to be heated.

Crucible removable for pouring if desired.

Standard shaped crucible to be used.

Melting Electrically

SEVERAL types of electric furnaces have been developed to melt both ferrous and nonferrous metals, each type having outstanding characteristics favorable to certain kinds of work. Information has been obtained during the past few years on an induction type furnace, which possesses interesting features. The design and performance of this type of furnace is described in this article, which is taken from a paper presented at the Syracuse meeting of the American Foundrymen's association, Oct. 5-9, 1925. The author is secretary and sales manager of the Ajax Electrothermic Corp., Trenton, N. J..

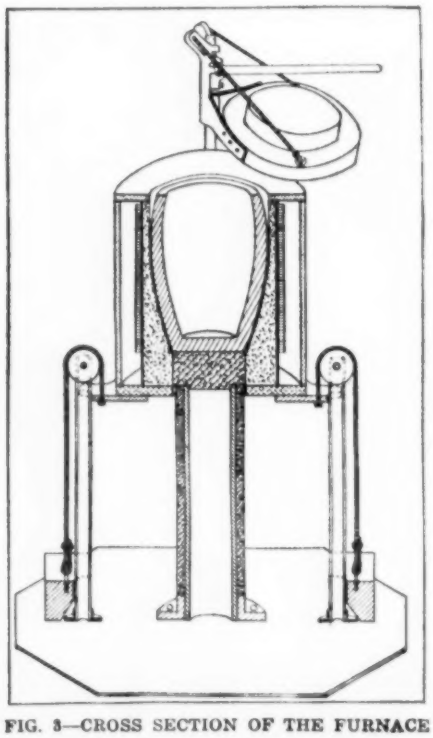


FIG. 3—CROSS SECTION OF THE FURNACE

High efficiency.

High power factor and steady, well balanced polyphase load.

It was found that the use of high frequency current made these features attainable. The furnace for foundry use is designed as illustrated in the cross sectional view Fig. 3. The metal is melted in a crucible surrounded by heat insulating material. The heat is applied by induction within the metal. The crucible requires no preheating.

There is no electrical connection between the crucible and the electrical circuit. The energy is supplied by electromagnetic induction from a coil surrounding the crucible and separated from it by about 1-inch. A heat insulating lining is located between the coil and the crucible, through which the electrical energy passes without affecting the lining material.

The lining has small mass in which little heat is stored. The coil consumes but little power and is kept cool by a gentle air blast. The furnace is housed in a cylinder or box of nonconducting material such as asbestos board. Fig. 1 shows the furnace in melting position.

The metal is charged as in an ordinary fuel fired crucible furnace. There are no flames except what little may come off from oil or other matter on the scrap metal being melted. The outside of the furnace

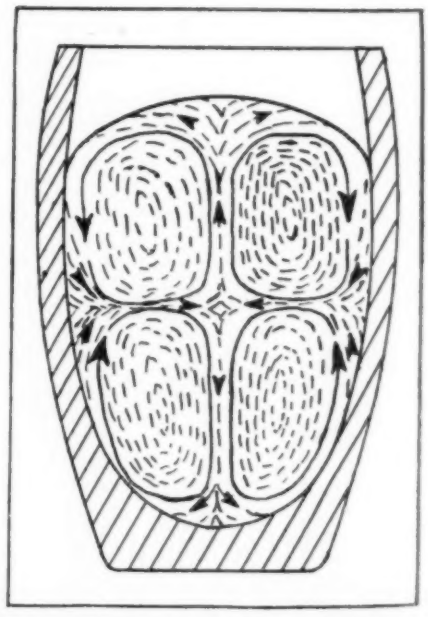


FIG. 4—LINES OF FLOW OF METAL IN CRUCIBLE DURING MELTING

is cool to the hand at all times. As shown in Fig. 2 the furnace housing may be lowered away from the crucible so that the crucible may be picked up with ordinary tongs and poured. The outside of the crucible never is heated hotter than the metal. This means that the crucible life is much longer than when the heat has to be passed through the crucible wall. Electromagnetic energy instead of heat passes from the outside to the inside of the crucible, producing heat where it is wanted, in the metal.

As soon as the metal starts to melt, forming a pool in the bottom of the crucible, violent stirring occurs in the metal, due to the attraction of currents set up in the outside of the bath. Fig. 4 indicates the direction of the lines of metal flow through any vertical section of the crucible. The action is such that the metal is elevated in the center about 2 inches higher than at the crucible wall. Flow lines of metal are plainly visible on the top of the metal bath, going from the center radially in all directions to the edge. As the metal is forced away from the wall of the crucible there is no wearing away due to stirring. Floating lumps of metal stay in or near the center of the crucible.

There is practically nothing to wear out about the furnace except the crucibles. The lining outside of the crucible never is in contact with molten metal except when a crucible breaks and the lining is not heated enough to cause any disintegration. There is, of course, some abrasion of the lining wall as it slides up and down on the crucible but if the crucible is well centered, the life of the lining is long.

The furnace housing is counterweighted and in the design shown in the illustration, the housing is supplied with a handle with which it may be raised and lowered without the use of power. In larger sizes provision is made for raising and lowering the housing by two air cylinders.

The power for operating these furnaces is derived from a generator of standard design driven by an ordinary induction motor or a synchronous motor. A number of condensers also are provided for bringing the power factor of the furnace circuit to unity. The power factor of the driving motor usually is about 90 per cent unless a synchronous motor is used in which case it may be made unity or leading.

The efficiency of the equipment is comparable with that of other electric furnaces operating on a 24-hour per day schedule. The high frequency induction furnace falls off little in efficiency when operated for only a few heats at a time. An example of the input of this furnace and of another type furnace is given in the following table:

High frequency furnace

Hours Operation	Lbs. per kw-h.	Kw-h. per ton	Other furnace Kw-h. per ton
8	6.60	303	351
9	6.63	302	338
10	6.68	299	325
24 x 5 = 120	6.95	287	.....
Continuous	7.00	286	273

The figures refer to red brass. On yellow brass the kilowatt hours per ton are about 20 per cent lower. The first melt takes about one and a half times as long as subsequent melts.

Application to Nickel-Iron Melting

One of the recent developments in ferrous metallurgy is the manufacture of small tonnages of nickel-iron alloys practically carbon free. The high frequency induction furnace has figured largely in this development. An alloy, which consists of about 78½ per cent electrolytic nickel and 21½ per cent electrolytic iron, was developed with the aid of one of these small furnaces in a laboratory of the Western Electric Co., New York. In 1922 two 100-pound furnaces were installed at the Hawthorne plant of the Western Electric Co., Chicago. It was specified that the carbon content should not exceed 0.06 per cent. When the writer was installing this equipment 10 successive 100-pound melts of this alloy were made of which the carbon content was reported as 0.01 per cent, or one point of carbon in foundry parlance.

An alloy of 50 per cent electrolytic iron and 50 per cent electrolytic nickel is being manufactured at the Westinghouse Electric & Mfg. Co. in a 225-pound high frequency induction furnace. The maximum carbon content is 0.006 per cent. The sulphur content is about the same. Otherwise stated there are only 6 parts of carbon or sulphur in 100,000.

The high frequency induction furnace has also proved practical for melting ferrous alloys in small quantities when the absence of carbon is not so important. Fig. 5 shows an installation of two 15-pound high frequency furnaces which are being

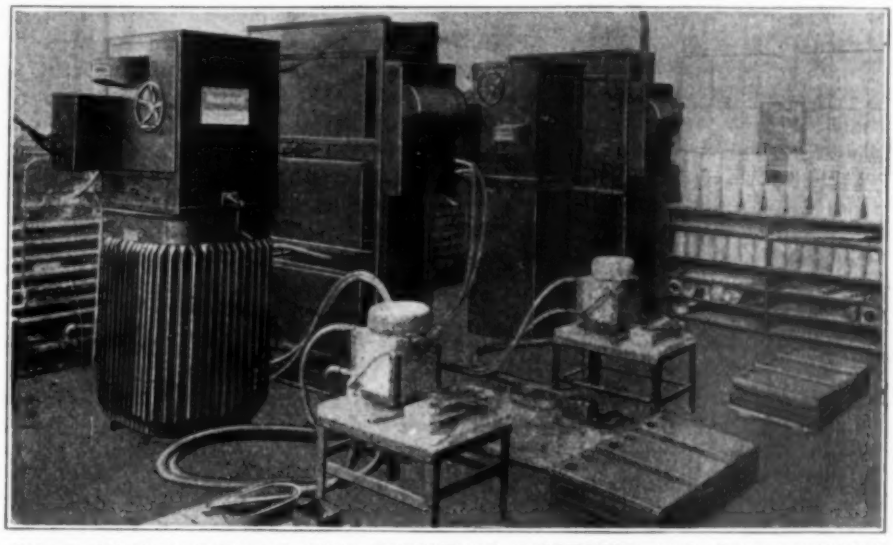


FIG. 5—INSTALLATION OF HIGH FREQUENCY CONVERTER AND TWO FURNACES

operated at the West Lynn plant of the General Electric Co. The metal melted is a special alloy and consists of 30 per cent copper, 66½ per cent nickel and 2 2/10 per cent iron. The balance of 1 3/10 per cent consists of impurities. For such small furnaces a high frequency current is used. Commercial power is transformed into high frequency power by means of a static apparatus known as a high frequency converter. Two such converters appear in Fig. 5.

An interesting development of high frequency furnaces has been carried on in England where the Gutta Percha Co. has installed 46 units similar to those shown in Fig. 5. Sixteen pound charges of low carbon nickel-iron alloy are melted. The crucibles in which the metal is melted are made of clay without graphite. Four of the 46 furnaces have been in use for a year or more. Sixteen were installed early in 1925 and the remaining 30 during the spring and summer of 1925.

In addition to melting all kinds of metals the furnace principle makes possible the heat treatment of steel and other materials. When heating magnetic metals the furnace circuit is affected when the temperature reaches the recalescense point, about 1380 degrees Fahr., so that it is possible easily to arrange for auto-

matic adjustment of the power supply to produce uniform heating. Thus it is possible to heat treat steel without danger of passing the recalescense point. Strips of bars of steel may be passed continuously through high frequency furnace coils placed close to the rolls or drop hammer in which the steel is to be worked.

For heat treating or annealing small pieces of metal a muffle or tube of heat resistant metal may be heated by a high frequency furnace coil around it. It is not ordinarily practicable to heat small or irregularly shaped pieces of metal by inducing current directly in them.

Summarizing the development of high frequency induction furnaces to the present time there are now on order or installed about 1500 kilowatts for melting nonferrous metals, about 1200 kilowatts for melting ferrous metals, about 1300 kilowatts for miscellaneous high temperature experimental work and melting precious metals.

Making Hard Iron Balls

(*Concluded from Page* 310)

per ton. Roofs made from special shaped brick run 550 heats while 350 heats are secured from under roofs built from standard shapes. On account of the cost, local silica brick are employed instead of the eastern product. Three men are required to operate the furnace which includes bringing the scrap in from the yard and charging it in the furnace. From the foregoing figures the operating costs for any locality readily may be ascertained.

The present schedule calls for 11 heats in each 16 hours of operation. Usually 4 heats of steel are made per week, 2 heats of gray iron per day, one heat per day for special white iron liners and the remainder ball metal. The monthly tonnage runs close to 500 tons divided roughly as follows: 3 per cent steel castings, 10 per cent hard iron castings, 27 per cent gray iron and 60 per cent balls. An 80 per cent yield of good castings is secured on gray iron, 68 per cent on steel and 75 per cent on balls

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The Rohne Electric Co., Minneapolis, has been reorganized and will be known as the Sta-Warm Electric Heater Corp. Edward F. Sparks is general manager of the firm which manufactures electric pots and heaters for glue, wax, etc., and other industrial electrical heating equipment.

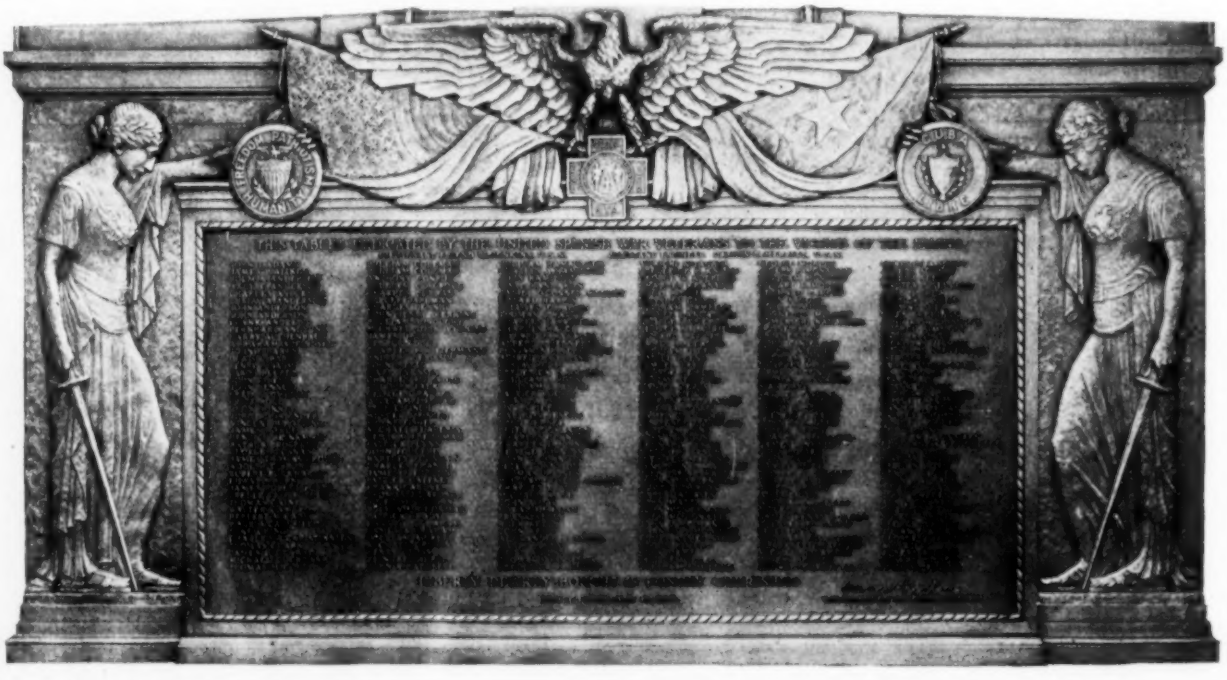
W. T. Clark recently has been appointed factory manager of the J. W. Paxson Co., Philadelphia.

Casts Memorial to Maine Victims

UNITED Spanish War Veterans recently placed a large bronze tablet on a monument at Havana, Cuba, as a memorial to the American sailors who died on the battleship MAINE *when it was destroyed Feb.* 15 1898. *The tablet was unveiled by Carmi A. Thompson, Cleveland, national commander of the U. S. W. V. at exercises participated in by the Cuban and United States governments.*

The tablet was designed by members of the staff of the W. S. Tyler Co., Cleveland, and was cast in the foundry of that company. The design was made by H. A. Goodman and the plaster models were executed by Frank L. Jerouch, sculptor for that company. The tablet measures approximately 7 feet in width and 4 feet in height and weighs 490 *pounds. The work was cast in two pieces in skin-dried green sand molds. The center panel containing* 260 *names was cast in one piece, while the large outer frame containing the eagle and cross flags, figures, shields and base was cast in one piece. The letters making up the names are* ⅛*-inch high and are of a rounded face design.*

The casting was made in an extremely short time. The order for the tablet was received the last week of December, after which the design was made and approved, the plaster models made, the castings poured, finished and assembled. The finished tablet was shipped on Feb. 1., *and was dedicated Feb.* 15.



How and Why in Brass Founding

By Charles Vickers

Bronze for Die Molds

We have a number of bronze castings to make that are to be used for dies to mold a composition under heavy pressure, and we do not know just what formula to use as the castings must be especially hard, but entirely free of brittleness or porosity. We have been thinking of manganese bronze, but are not sure that it would be suitable.

An aluminum bronze containing about 11 per cent aluminum is suitable for these dies, but it requires careful molding, gating and applying of riser to get clean, sound castings. The bronze must be backed into the molds instead of being flowed directly into them, and heavy risers are required to avoid shrinkage cavities.

A copper-tin bronze also can be used. An alloy of copper 85 per cent; tin 15 per cent, should be hard enough. This metal is very fluid, due to the high percentage of tin and it must be poured at as low a temperature as possible and have it fill the molds, otherwise the castings will be rough of surface. It can be made to flow smoothly by the addition of aluminum; adding one ounce to the hundred pounds of alloy. The way to do this is to melt the tin in a ladle first, and to each 15 pounds add one ounce of aluminum. The copper then is melted as usual under charcoal, and the remelted and alloyed tin is added. The metal will be fluid, but will not burn into the sand.

Wants Sand Pickle

We want to know the kind of acid that is used to pickle brass castings to remove the sand without injuring the castings. We have no sand blast, and the castings are too heavy to rattle as they would get battered up making them difficult to polish.

For removing sand from brass castings the following dip is frequently used with success: Hydrochloric acid 6 gallons; nitric acid 1 gallon; water 2 gallons. Submerge the castings and leave in the solution for about ½ hour, or more if required, to loosen the sand. Then remove and rinse in boiling water. Hydrofluoric acid also is used to remove sand from castings. It dissolves the sand and has no effect on the metal, but has to be renewed frequently and is on that account rather costly.

Better results will be obtained by the use of the sand blast and it is possible to clean the castings of sand then dip them in the regular dipping acids to obtain color, thus producing castings greatly superior to the general run, and being in a position to ignore the ordinary competitor who cannot supply decently finished castings that will demand a reasonable price.

Information Is Lacking

When making match plates for molding malleable castings we experience finning or sheeting on some of the castings made from the plates, when the mold is properly rammed and the plate lifted, the drag is dusted with a white dust and the cope is closed to print the parting line. When the cope is removed we note several places unprinted, which mean a fin on such castings, probably thin as paper. With grey iron this does not show, only with malleable due to the temperature at which the metal has to be poured. The flask we use is perfectly straight over the top, that is, it is not hollow, and the weights are machined on the side that rests on the mold. We will appreciate your comments on the cause of this phenomenom.

As we understand the matter, after the plate has been completed it is used for a test mold, which in making the cope is closed over a dusted drag which marks the parting lines and also shows fins, the latter being unprinted surfaces. The question is; what causes the drag to sag away from the plate, so the cope fails to connect when closed, after the plate is removed. The answer to this is *we do not know*, and the reason we make this statement is that we fail to understand how such a thing could happen mold after mold. In one mold, the bottom plate or board might not be bedded level, but this would not occur with all molds. Also a shrink on the plate would not effect the joint parting. This seems to be one of the many problems, in which, it is necessary *to be on the job* to understand. Therefore, we are unable to give you any advice that would not sound like *piffle*, with the information supplied us.

Brass Boils When Zinc Is Distilled

In melting clock-works we have charged them into a crucible with charcoal and then have placed a cover over the pot. When the brass has melted and the heat is raised, a bluish smoke with flames bursts from under the cover and the whole mass becomes a boiling, effervescing mass. What is the cause of this. We think it is due to burning the zinc from the brass and wonder if the temperature should be increased. While the castings from sand molds appear solid, some fail to fill the mold and present a surface like worm-eaten wood especially on the upper parts. We are using a good grade of molding sand but would like to learn the exact procedure to make it ready for casting. What should be mixed with it, and in what proportions should the mixture be made?

It is perfectly natural for the molten brass to act in the manner outlined. It is of course, due to the distillation of the zinc from the metal, and the formation of zinc oxide on contact with the atmosphere. It is not necessary to put a cover on a crucible when melting yellow brass; the covering of charcoal being sufficient. If the molten metal fumes and *boils* it is plenty hot enough. Yellow brass has to fume strongly, and cause a vibration through an iron bar, when the latter is held in the metal, and such vibration is held as an indication by the experienced yellow brass melter that the metal is at the proper temperature for pouring into the molds.

The loss of zinc after all this fuss is not as much as might be thought. However, it may be made to lie quietly by the addition of a small amount of aluminum; about one ounce per hundred pounds of brass. The reason the castings fail to fill out properly is twofold. The gates are too small to feed the castings, and the brass is poured too slowly. Yellow brass, minus aluminum has to be poured with decision. The sprue head must be kept filled, even though brass is spilled over as the mold fills up. Slow pouring is also the cause of the worm-like marks on the castings. These are produced by the zinc smoke

which condenses on parts of the mold surfaces in long streamers, caused by the current of moving air within the mold. Pouring fast enough to fill the heads, and keep them filled, seals the mold against entrance of air and greatly limits oxidation of the zinc.

The grade of molding sand mentioned is perfectly satisfactory for making molds. It requires mixing with nothing but clean water and only a sufficient amount must be used to dampen the sand to the point where it will stick together when squeezed in the hand. Squeeze a ball of dampened sand, then toss it upwards a few inches catching it in the palm of the hand. Keep doing this a number of times, and if the ball becomes wet on the surface, the sand is too wet, and the molds will blow. It is not necessary to mix old molding sand with the new, as the latter may be used safely but in time it will burn black, due to the combustion of the organic matter in the sand, and also to getting dirty.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of The Foundry or of its editors.

Recommends Change in Listing Alloys

To the Editor:

The summary of currently manufactured aluminum—base alloys contained in the article by Mr. Pannell on page 105 of your issue of Feb. 1, 1926 is extremely interesting and useful. However, its utility would be greatly increased and also the possibility of misapplication of the data decreased, by quoting the composition and physical properties of all of the alloys in the same manner. In some cases he has given the mean composition of the alloy, and in other cases the mean of some elements and the maximum permissible for others, the latter usually impurities. In a similar manner some of the data on physical properties are specification values (i.e. minima resulting from good manufacturing practice) and in other cases either the results of single determinations or the average properties.

It would seem preferable in a tabulation such as this, to give either one or the other of the above types of values, or perhaps the range of values to be anticipated under normally good production conditions. By so doing, and stating the character of data presented, an improper comparison of the properties of one alloy with those of another would be avoided.

In the first column of page 107, the problems involved in pouring the naval gun factory alloy have been referred to. Mr. Pannell is not the only writer who has mentioned the same apparent difficulty, but inasmuch as toward the bottom of the column he has explained the reason for similar difficulties by the unitiated in handling the aluminum-zinc-copper alloy, and also since the same facts apply to the case of the copper-manganese alloys it would seem well for him to have referred to these difficulties in a similar manner.

JEROME STRAUSS,
Material Engineer, U. S. Naval Gun Factory.

Aluminum Alloys Are Hard to Compare

To the Editor:

The comments of Mr. Jerome Strauss of the United States naval gun factory are pertinent and well taken.

I always personally have felt that there is room for a wide open discussion of the aluminum alloy situation because so much development work has been done by different investigators along parallel lines without a thorough exchange of ideas. For this reason, as Mr. Strauss has probably noted, the tables of alloys will show two or more having virtually the same composition but with different physical properties, as reported by different authorities. It does not seem possible to co-ordinate these different values unless some authority were to take the entire range of alloys and test them all under identical conditions. Since this evidently has never been done, the only course left to the author was to quote the published figures for what they were worth, giving in each case the authority for them. There seems to be some justification for quoting the mean composition where it relates to added constituents because these usually are permitted to vary over a range. However, the maximum content of any impurity is the best way to express it and this usually is recognized by official specifications.

It is pleasing to note that Mr. Strauss is of the opinion that the difficulties of handling the alloys of aluminum with small percentages of copper and manganese have been exaggerated. I did not refer to them in the same terms as those used in describing the aluminum-zinc-copper group because the difficulties are of quite a different type. Most foundrymen who have used both types of alloy will agree that those containing zinc with a small percentage of copper are remarkably fluid and easy to pour into thin sections. This is not the general experience with the aluminum-copper-manganese group. The trouble experienced with zinc alloys, such as shrinkage cracks, generally can be avoided by careful preparation of the cores and by shaking out the castings immediately after pouring. On the other hand, the somewhat troublesome pouring properties of the aluminum-manganese-copper alloys could only be modified by a change in the composition of the alloy.

ERNEST V. PANNELL,
165 Broadway, New York.

Who Pays When Castings Are Returned?

To the Editor:

We would like your assistance and that of the readers of THE FOUNDRY in deciding a controversy which has existed between us and a manufacturer for whom we formerly made castings.

These castings were brass valves and fittings which had to withstand a water pressure of 125 pounds, to be of a deep orange color, and to machine readily. At first, no trouble was encountered in withstanding the pressure, but later our customer redesigned all pattern equipment and made the walls of the castings thinner on the recommendation of their engineering department.

Our troubles then began with leaky castings. We tried to remedy these by stiffening the metal through the addition of tin. The original metal contained only 1 per cent; but our customer's machine shop complained and refused to machine them, although the castings were made from a mixture of copper, 85 per cent; tin, 4 per cent; zinc, 6 per cent; and lead, 5 per cent-all new metals. Naturally, this alloy would be somewhat harder than that of low tin

content, as tin has a hardening effect.

Quantities of these castings were returned to us, billed at full purchase price plus machining, assembling and disassembling labor costs. Even overhead was added. We objected to this procedure and instructed them to remove their patterns as their business was no longer desirable. We billed back all labor charges and overhead, but credited the scrap at a prearranged return price based on 80 per cent Lake copper.

The controversy is—*Who should stand the loss?*

Our customer maintains that we must pay for the returned castings at full purchase price. We believe that the foundry is allowed a small percentage for hidden defects in pressure castings.

Another case in which we would like to know the relation between the brass foundry and the purchaser is as follows: One hundred pounds of castings are sold at 25 cents a pound. These castings average 10 pounds each. In machining a defective casting is found and returned for replacement. The returned casting now weighs 8 pounds.

What disposition is made in accounting for the material turned off?

Is it customary for the purchaser to be credited as though he returned full weight, or is he given credit for the casting at full purchase price for full weight and then charged with the weight of the turnings, or the difference between returned castings and castings as sent him originally?

We would like to have these questions discussed in THE FOUNDRY because we believe that others in the foundry industry have been placed in similar situations, and will give us the benefit of their experience.

A. READER.

Wild Guesses or Estimates

(*Concluded from Page* 307)

ness, measured by sales.

A *Shipping Expense* account is carried in the general ledger, where all transactions in shipping the product are recorded. A memorandum of the percentage of shipping cost to sales volume is made each month to arrive at normal rates to add to cost estimates. The fluctuations in individual months may be so violent that the average for several months is a better percentage to include in estimates.

SELLING—Foundries may be divided into three general classes, namely: Those that confine their operations to jobbing work; those that make castings only for their own use; those that make castings for their own use and take in outside work to maintain a normal melt.

At times it is necessary to make up estimates of cost for future work, in each of these types. The selling expense is different for each type.

The manufacturer who makes only jobbing work, must add all his selling expense to the product before he can realize a profit, whereas the one who makes castings for his own exclusive use adds no profit to his foundry product until such time as he sells the machined part, either singly or assembled. The real difficult problem of selling cost falls to the third type, those that take in outside work to maintain a normal melt. This class first must separate the selling costs into classes of product sold, then the portion chargeable to foundry is added to production and shipping costs on the basis of volume of business.

The work of the cost accountant does not stop with the determination of the cost to produce. Selling expense is just as much a cost of the article as the molding labor, and should receive careful analysis if estimates of costs are to be made that will guide the foundryman in making sales prices that will stand the acid test of 1926 competition.

British Foundrymen Hold Annual Dinner

Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen held its annual dinner March 13 at the Engineers club, Birmingham, England. Several visitors were present and included John Cameron, president, F. J. Cook, vice president, V. C. Faulkner, president elect, Institute of British Foundrymen, and Vincent Delport, European manager, THE FOUNDRY, and representing the international committee of the American Foundrymen's association.

Prof. Thomas Turner in his speech said that most metals used have to be either molded or cast and therefore, the foundry industry is a fundamental branch of industry in general. Although casting seems to be simple, a great technical and scientific knowledge is necessary to determine the composition of the metals, changes during melting, uses of fluxes, etc.

Mr. Delport presented the invitation of the American Foundrymen's association requesting British foundrymen to attend the second International Foundrymen's convention at Detroit from Sept. 27 to Oct. 1. He also outlined the arrangements made for the convention and tour.

Tests Machinability

Although the tests are incomplete at present, E. J. Lowry, metallurgist of Hickman, Williams & Co., Chicago, has found some interesting results in his investigation of the machinability for wearing properties of castings in relation to the pig iron used. In a recent talk at Boston, Mr. Lowry exhibited charts showing results obtained from ten different pig iron mixtures. Some of the properties illustrated in this chart are shown in Table I. It will be noticed that the silicon, manganese, sulphur and combined carbon in the pig iron were kept practically uniform. The results are interesting for two reasons. They show a wide variation in strength and machinability with almost no variation in chemical composition, and they show that there is no direct connection between the hardness as shown by the Brinell test and machinability as shown by power consumed in machining under identical conditions.

Mr. Lowry has given some of his conclusions as follows:

Machinability and wear of a casting are not factors of its hardness and strength.

The carbon formation in the pig iron used carries through the cupola melting into the casting. Machinability of the casting is primarily dependent upon the structural form of the carbon in the iron.

TABLE I

Analyses of Iron and Results of Physical Tests

	PIG IRON			CASTING				
Mixture	Per cent silicon	Per cent manganese	Per cent sulphur	Per cent silicon	Per cent manganese	Brinell test	Strength	Power consumed*
G	2.22	0.67	0.05	2.30	0.67	217	3300	54
J	2.25	0.73	0.06	2.03	0.72	163	2900	60
F	2.22	0.70	0.05	2.06	0.70	187	3450	52
B	2.24	0.72	0.05	2.29	0.81	156	2800	60
C	2.23	0.71	0.06	2.09	0.78	196	3350	75
A	2.25	0.68	0.06	2.31	0.75	163	2800	60
D	2.22	0.73	0.06	2.03	0.78	163	2800	57
H	2.23	0.63	0.05	1.98	0.65	196	3250	45
K	2.10	0.71	0.06	2.03	0.71	196	3350	66
E	2.22	0.74	0.05	1.95	0.70	202	3500	58

*Power consumed in kilowatt hours in machining the castings.

Bill Explains Why Molds Cut on the Face

By Pat Dwyer

OUT of all the material in the technical papers that pass through Bill's hands I think he derives the greatest pleasure from the personal pages where the comings and goings of men connected with the iron and steel industry are recorded. Perhaps one of the reasons is a natural curiosity to know who is who, what they are doing and why. The principal reason is that he knows many of them personally, and many more by reputation. If he does not know the individuals he is familiar at least with the name and character of the establishment to which they are going or the plant from which they have resigned. Sometimes the names call up pleasant memories and he is genuinely pleased to note that merit has been rewarded and the men have assumed more responsible and remunerative positions. He pats himself figuratively on the back each time and says he always knew that lad was going to land in the big league. Other names he passes over indifferently, but a few in a third class always take the wind completely out of his sails. Whenever he sees an item in the paper to the effect that one of these men has accepted an important position here or there, he throws up his hands and wonders profanely how in the name of Judas Iscariot these birds get by with it!

He showed me a clipping the other night which stated that—well let us say—J. H. Von Dismal had accepted the position of open-hearth superintendent of the Peninsular & Oriental Steel Co., which of course as you probably are aware is located between the Great Lakes and the Gulf of Mexico and between the Atlantic and Pacific ocean.

"Unless that bird has learned a whole lot since I knew him," said Bill, "he is about as well qualified to run an open-hearth as I am to conduct a beauty parlor or act as secretary of the United States treasury. I have not seen or heard of him for about 20 years, but at that time he was a Lulu. He could tangle the cranes and the furnaces in a tighter knot and create more confusion than any man I ever saw in an open-hearth plant.

"Back in the good old days before the war, Germany continually was held up as a model in nearly everything, including the highest pinnacle of perfection in technical achievement. Benevolent gentlemen who occupied the platform at school commencements never failed in their remarks to weave in reference to the splendid school system of Germany. My own private opinion is that the majority of those citizens knew as much about Germany as I do of the identity of the lad who struck Billy Patterson. Somewhere, sometime they had heard a reference to this wonderful school system and they just naturally felt that passing the word along would enhance their own reputation for omniscience. 'Tis an almost universal form of disease, but it breaks out in its most virulent form among corpulent gentlemen who infest school platforms and other public places.

"Earnest young men engaged in taking night courses of instruction under the auspices of various more or less charitable institutions were treated to the same general line. Instructors in mechanical drawing, machine design, shop practice of all kinds never failed to refer familiarly to how much better these subjects were taught in Germany. According to all accounts Germany was the most advanced country in the world and this commanding position was due to the fact that every young man was a duly qualified engineer when he was graduated from school. The story may have been true. I don't know. However, I couldn't help wondering occasionally who did the rough work, the hewing of wood and drawing of water, if all the men were superintendents. Honest labor is honorable, but somehow I could not visualize a haughty young Prussian engineer contentedly pushing a wheelbarrow load of pig iron up the runway leading to the charging platform."

"Would you mind telling me," I said, "what all this has to do with Von What's-his-name who tied the cranes in a knot? You will pardon my density, but naturally I assumed you were going to tell me about one of these supermen who twist rails into true lover's knots with their bare hands."

"You certainly are the original hurry up kid," said Bill. "This bird twisted a good many rails into queerer shapes than true lover's

knots before he was through, but he did not do it with his bare hands. In fact I don't believe he ever went around in his bare hands. He always wore kid gloves.

"Just about the time this worship of German technicality was at its full flood, the company with which I was connected in the humble capacity of steel foundry foreman decided to import one of these highly finished products of the Fatherland and place him in charge of the open-hearth department.

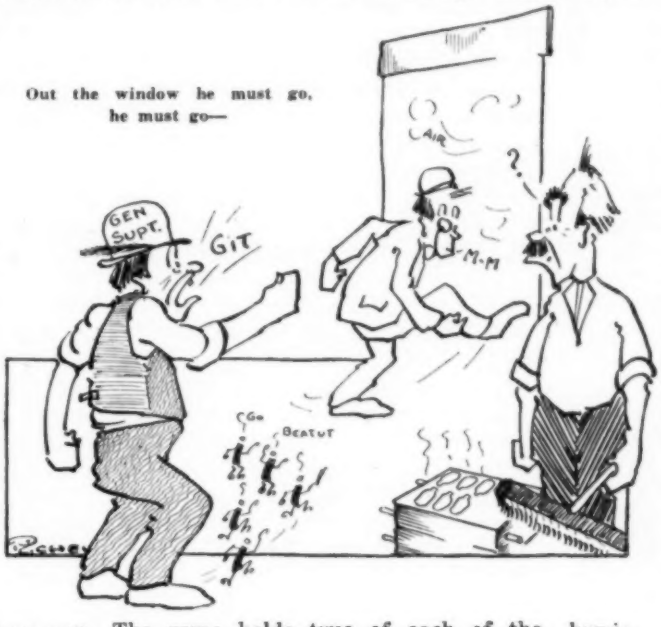
"Ten 50-ton tilting furnaces were arranged in a straight row down the center of an 800-foot building. They were served with cold stock in front by two charging machines and on the back by three 75-ton cranes which charged the furnaces with a certain amount of hot metal from the blast furnaces or the mixers and later handled the ladles when the steel was tapped into them. The position of superintendent did not call for the service of a magician or the cleverest man in the world, but, on the other hand as you might say, it was no job for a boy.

"The mill was provided with three pouring platforms each one of which was equipped with a hydraulic pusher which moved the train of ingot molds forward one at a time as it was filled while the ladle of steel, suspended from the crane above them, remained stationary.

"Theoretically each crane was supposed to serve the three or four furnaces in its immediate vicinity and pour the steel at the nearest platform. Unfortunately owing to the great number of variable factors that enter into the operation of a battery of open-hearth furnaces, this theory couldn't be put into practice.

"A crane is laid off repairs occasionally. Failure to shunt a train of ingot molds in time causes a heat from No. 1 furnace to be taken to No. 3 platform. A stubborn heat in No. 5 furnace delays the tapping time so that No. 7 has to be tapped first. Hot metal ladles have to be emptied before the iron freezes. The hunkies in the pit 'No can do' until the loaded slag pans are lifted from the pits and replaced with empties. The boss bricklayer protests to high heaven at the injustice of charging him on the report sheet of No. 6 with a half hour delay in changing cages over the ports when he could not get a crane to do the work.

"A battery of open-hearth furnaces runs continuously day and night until the roofs or side walls fall in, but they do not tap in regular sequence or with the precision and accuracy with which the cylinders in a motor block follow each other in the order of firing. No. 1 may be first on one shift and then through any one of a hundred causes may be third or fourth or even last on the following shift.



Out the window he must go, he must go—

The same holds true of each of the remaining nine and the result is a constant juggling of cranes and pouring platforms to take each furnace when the heat is ready.

"Our hero may have been a skilled metallurgist. I am not in a position to pass judgment on his qualifications in that line. Most assuredly he had no knowledge of how to handle men or equipment. If he had confined his efforts to the side of the business with which he probably was familiar and if he had kept his eyes and his ears open he might in time have developed into a competent superintendent. Unfortunately, he was obsessed with the idea that he only had to issue orders, impossible orders, and have them executed instantly. He walked up and down the mill immaculately dressed and with the ends of his Kaiser moustache pointing fiercely upward. The open-hearth crew invariably referred to him lovingly as *The Count*.

"The climax by which he always will be remembered occurred after a spectacular spill at No. 1 plaform. The ladle man could not lift the stopper over the first ingot mold. His helper placed the pricker on top of the mold and the craneman lowered the ladle so that the point of the pricker might push the stopper up out of the nozzle. Unfortunately instead of entering the opening, the point of the pricker caught the edge of the nozzle and pushed it up out of its seat. Instantly a torrent of steel gushed forth, but instead of falling straight into the mold the stream was deflected by the crooked nozzle brick so that a considerable amount splashed all over the platform.

"Members of the pouring crew dashed through an emergency exit in the back wall and thence by stairway to the ground. Enveloped in an atmosphere of flame and smoke, the craneman was confronted with the alternative of standing by his controls where he stood an excellent chance of frizzling like a slice of bacon, or of descending to the platform where the sheet of molten steel would absorb him like a drop of ink on a sheet of blotting paper.

"All the heroic acts are not performed on the field of battle. Wrought up to a high pitch of excitement and *berserk* rage men have performed prodigies of valor in leading forlorn hopes, in stubbornly contesting every inch of a hard won vantage and in preventing the flag from falling into alien hands. History is replete with instances of men who fought and died, but who never surrendered until the last red drop of their heart's blood had gushed forth in defiance.

"Men in the hazardous steel industry are not buoyed up by the excitement that surrounds the soldier, but in many instances when the pinch comes they stand by their posts as loyally as any soldier who sank to his death on a stricken field, in defense of the flag he was sworn to protect.

"Heritage of the fighting blood that had brought his ancestors out in the '45 to swing Scotland's broad claymore in defense of bonny Prince Charlie at Culloden kept the craneman at his post until he had racked the ladle out about 10 feet and lowered it down to the track that skirted the edge of the furnace pits. Then he collapsed on the floor of the cage from which he was rescued some time later with practically all the clothing burned from his body.

"On the following day the Count was confronted with the man-sized job of clearing away the wreck. The steel had filled the space between the rails for a distance of 20 feet and had overflowed on both sides in an irregular shape from 10 to 15 feet in width about a foot thick in some places.

"You never would guess how he went about the job. All this happened before the acetylene torch was introduced and the mass weighed

nearly 50 tons. He decided to cut the slab into four sections so that they might be lifted readily and to that end he actually set four gangs of men to work with sledge hammers and cutters to carve a channel through two centers, from side to side and from end to end.

"The mill men fumed and cursed among themselves at the delay incident to this silly performance, but repeated rebuffs had taught them to keep their own counsel and they said nothing to the Count. The general superintendent of the plant was away at the time of the accident, but he arrived on the scene about 24 hours after the nibblers had started to gnaw their way through the steel slab.

"Boy! That old bird was the original cat's whiskers. He had experience managing steel plants in this country, in England, in Russia and in Germany, and he could express himself luridly and profanely in all four languages. He was singularly gifted in many respects. Owing to a limited education I missed many of the fine points, but I was *fair lifted*, as the Scotch say, when he addressed the Count in our native tongue.

"He sent for the boss rigger and his gang and these handy lads slipped a wire sling under each end of the mess in jig time. They hooked the slings on the main hoist of two cranes and tore up the whole outfit, rails, scrap and half burned ties and loaded the wreck on a flat car which then was shunted out to the skull cracker. The railroad repair men had a new track down in a couple of hours and the incident was closed."

"Reference to the steel mill and ingot molds," said Bill, "reminds me that I had a letter the other day from a lad who was making ingot mold stools 3 feet 6 inches x 10 feet x 8 inches thick. He said the iron entered the mold through a double bottom pour gate at one end, but castings were rough and the face was badly cut in front of the gates. The cope surface was perfectly clean and showed no evidence of draws or scabs. He used a facing sand made up of a fairly coarse new sand, 10 shovels; old sand, 30 shovels; sea coal, 6 shovels. This mixture was wet down with plain water and the surface of the mold was covered with the best grade plumbago. The molds were not dried. He wanted to know if I thought the facing sand was to blame and if so could I suggest a suitable mixture.

"I pointed out to the writer that 5 tons of molten iron is quite an amount to pour over a green sand face 3 feet 6 inches x 10 feet and unless several precautions are observed the face of the mold will cut irrespective of the quality of the sand used in the facing. From the fact that the sand on the cope side did not cut or draw down I decided that the trouble was not due to the sand, but to the manner in which it was manipulated.

"The rough surface on the casting might be due to erosion or scabbing or to a combination of both. Erosion in some cases is due to using a sand in which the bond is not sufficient to hold the grains against the force of the stream of iron. In other cases where a satisfactory grade of sand is too wet or rammed too hard, the steam loosens the sand on the surface of the mold. The flowing iron carries the loose sand away and produces an effect similar to erosion. In the present instance I was inclined to the opinion that the trouble was due to a combination of hard ramming and lack of venting.

"He did not state whether he was bedding the pattern in the floor or rolling it over in a drag so I touched briefly on both methods. Since he probably was bedding the pattern in the floor I described that method first.

"The pit is dug 5 x 12 feet, 18 inches deep and a 4-inch thickness of coke or cinders is spread over the bottom. A 4 or 5-inch vent pipe is placed at two diagonally opposite corners to carry the gas from the coke bed to the air above the foundry floor. If a considerable number of castings are required, two straight sections of rail at least 10 feet in length are leveled on suitable blocking in such a position that the upper face is 8 inches below the floor level. The rails are spaced about 4 feet apart, and are designed to serve as permanent straightedges in making the bottom face of the mold. If only one or two castings are required, wood straightedges will serve satisfactorily.

"The space under, between and outside to the top of the rails is filled with heap sand and tramped over once. The tramping lowers the level of the send between the rails. This space then is filled with facing sand to a height of about 1 inch above the rails. The facing is tramped lightly and then the entire surface is vented down to the coke bed. A ¼-inch vent wire is not too heavy and the vent holes should be spaced not more than 2 inches apart. The superfluous sand then is scraped to one end and used later to face the sides of the pattern. A short straight edge see-sawed back and forth and with the ends constantly resting on the rails serves to produce a flat level bed for the reception of the pattern.

"If the pattern is rolled over in a drag, the first 4 inches of sand next the pattern is merely tramped. The following course, if any, may be butted with the rammer. The bottom is vented freely before the bottom plate is clamped in place.

"As an added precaution I suggested he either should mix a little core binder with the facing sand, or spray the face of the mold with molasses water or a thin solution of core binder. Also it might be advisable to surface-nail the face of the mold in the immediate vicinity of the gates."

"This habit of writing letters" I said "May suit you but it would not appeal to the colored preacher who called upon his white cowrestler and found him writing the next Sunday's sermon. 'Ah ce'ntly nevah does dat! he exclaimed 'De ole debbil am a lookin' right ovah yo' sho'lda an' knows ev'yting yo' am a gwine to say an' he am prepa'ed fo' yo'. Now Ah don' make no notes an' when Ah gets up to talk needa me no' de debbil himself don' know what Ah am a gwine a say!"

ONE WORTHY BROTHER SLIPS ANOTHER A LITTLE CONFIDENTIAL INSIDE DOPE ON THE ECCLESIASTICAL SITUATION

CARE REQUIRED *in Molding Bolt Cutter Handles*

A HAND bolt cutter, which is a familiar tool around most metal fabricating plants, consists of short drop forged tempered blades to which are attached relatively long malleable iron handles. The connection between the handles and the blades is such that a strong lever action is produced, making it possible for 1-inch bolts to be cut by hand with comparative ease. Due to the long, slender and rather complicated design of the handle its production in a malleable foundry often is a difficult task for the foremen and molders.

Fig. 1 shows the mold of a typical design of handle. Here two handles are cast in each flask. The equipment consists of an aluminum plate and a standard make of squeeze molding machine. To get metal to flow freely throughout the length of the handle, it was found necessary to gate at four points. Yet when these four gates were used, cracks developed at or near the center gates. A shop foreman was then faced with a serious problem. When using two gates, one located near each end, the casting often was defective near the center due to poor flow of metal and when using four gates, shrinkage cracks developed at the center gates. Many changes in design and location of gates were made in an attempt to secure an arrangement which would overcome both of these difficulties. All experiments indicated that four gates were absolutely necessary. The question then was to prevent the shrinkage cracks. This was done finally by cutting the two central gates from the casting just as the metal became pasty.

This relatively simple procedure completely eliminated the trouble and now is the established practice. The molds are made up in the usual way. The handle cores are held in place with a transverse wire to avoid the necessity of having a long core print. When the cores all have been set and the mold closed ready to be poured, four marks are made with a template on the top of the mold showing the places where the gate cutter is to be inserted. After pouring, the molder takes a sprue cutting knife consisting of a flat strip of steel, about ⅛ inch by 2 inches, flattened and sharpened at one end, and forces it quickly through the sand at the four points marked. In this way the connection between the gates and the casting is severed.

During the experimental work these handles were made up by hand using cast brass gates for the pattern. With this equipment a molder getting $6.80 a day would set up 25 molds, figuring 27 cents a mold. With the match plate and squeezer a man and helper together set up 100 molds at a cost of 13 cents a mold.

The handle cores are made up in units of two fastened together by the wire which is used to hold them in place in the mold. Fig. 2 shows the coremaker at work. A simple hand tamped core box is used. This is opened and the freshly formed cores are turned out on a cast iron drier and placed in an oven conveniently located behind the coremaker. Each core is vented and reinforced. For this two wires are placed in the center of each core as shown at the right of the core box in the illustration and one wire later is withdrawn. Eighty cores per hour is the average production of the man shown at work.

Appoints Representatives

Milwaukee Electric Crane & Mfg. Corp., Milwaukee, has appointed A. H. Ellison as district representative in the New York territory, with offices at 50 Church street. In the Chicago territory Byron B. Evans will represent the firm with offices at 11 South La Salle street. This company manufactures electric traveling cranes and hoists.

Awards totaling $38,938 were paid 3433 employes of the General Electric Co., Schenectady, N. Y., during 1925 for suggestions made by workers which improved working conditions or tended to increase the efficiency of the company's operations.

FIG. 1—BOLT CUTTER HANDLES ARE LONG, THIN MALLEABLE CASTINGS WHICH REQUIRE UNUSUAL CARE IN MOLDING AND POURING. FIG. 2—THE HANDLE CORES ARE MADE IN PAIRS AND ARE HELD IN PLACE IN THE MOLD BY MEANS OF A TRANSVERSE WIRE

Rules Allow for Shrinkage

Patternmaker Finds Rules Made of Steel Exceptionally Serviceable, Especially When Making Fine Measurements

By Walter C. Ewalt

WHILE wood rules are serviceable for rough measurements, steel rules are superior for making finer measurements. Steel rules do not wear out as quickly and the lines and figures remain distinct much longer on them than they do on the wood rules. The same thing applies to the wearing qualities of the ends, corners, and edges. Of course, wood rules are satisfactory for many jobs. If necessary, thirty-seconds may be estimated, but many patterns and coreboxes are measured to within one-half of 1/64 or .0078-inch or less and it is much easier to divide 1/64 by 2 than it is to divide 1/16 into 8 parts. One-sixteenth generally is the smallest graduation on wood shrunk rules.

Steel rules, one of which is shown in Fig. 1, are classed among the finest mechanical tools. They are prized by mechanics because of their precision, workmanship, design and finish. The real mechanic spends time in taking care of them and he keeps them oiled and shined. He is careful not to mar them because he takes pride in being exact in his work. Accuracy should be learned first and then when that principle has been absorbed, it will be time to develop as much speed as possible.

Steel rules are light and should be tempered, for quite frequently they are used as straight edges. In many cases in certain pattern shops, it is necessary to use standard rules more or less in measuring castings, drawings, various tables, etc. and so the rule shown at Fig. 1 is given merely as an example of a good type to use.

It may be noticed that the graduations are in the English unit of measurement. On one side, along the edge, the graduations are eighths and sixteenths and at the ends in thirty-seconds. On the other side, the graduations are thirty-seconds and sixty-fourths. It may be seen that at each division of ⅛-inch, the number of sixty-fourths from the end, are indicated. These figures are given for the purpose of reading the rule quickly and they also assist in relieving an eye strain. A 12-inch rule of this style will be found convenient but it may be obtained from 2 to 24-inches in length.

Steel rules may be obtained in many styles and sizes and graduations such as beveled edge, thin, heavy, flexible, semiflexible, stainless, narrow, etc. It is best to choose the type of rule which will be suited best to the kind of work being done.

Many rules used by patternmakers are different from the types generally used. A pattern must be made larger than the resultant casting. Patternmakers use rules which allow for shrinkage of the different kinds of metal.

In a general way, the various metals will shrink as shown in the following table. However, it must be remembered that each individual casting must be considered with reference to shrink. Some kind of a standard for shrinks must be made and a 1-inch round bar of the different metals, 12 inches long closely approximates the table as follows:

White metal, 1/16-inch in 1 foot.

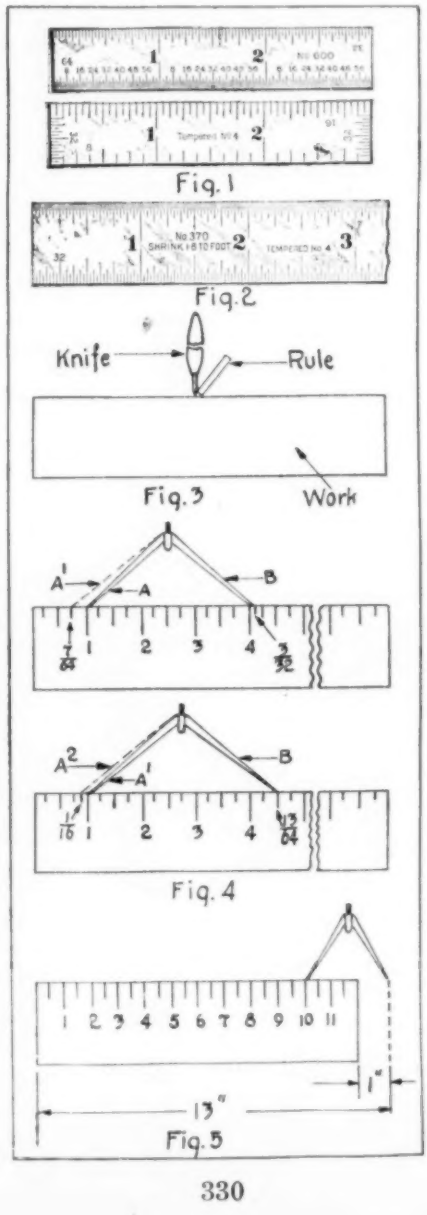


Fig. 1—One Type of Steel Rule Commonly Used By the Patternmaker. Fig. 2—The Amount of Shrinkage Is Noted on the Rule. The Shrinkage Scale Should Appear on Both Sides of the Rule to Avoid Mistakes

Fig. 3—The Rule Is Tilted To One Side When Marking the Work With a Knife. Fig. 4—Method of Adding Distances With the Rule and Dividers. Fig. 5—Making Measurements Longer than the Rule

Hard malleable iron ⅛-inch in 1 foot.

Malleable iron when annealed expands 1/16-inch per foot.

Small cylinders of cast iron 1/16-inch per foot.

Beams and girders of cast iron 1/10-inch per foot.

Thick brass 5/32-inch per foot.

Iron pipe ⅛-inch in 1 foot.

Steel ⅛ to ¼-inch in 1 foot.

Zinc 5/16-inch in 1 foot.

Lead 5/16-inch in 1 foot.

Tin 3/32-inch in 1 foot.

Copper 3/16-inch in 1 foot.

Bismuth 5/32-inch in 1 foot.

Aluminum 3/16 to 1/5-inch in 1 foot.

Britannia 1/32-inch in 1 foot.

Large cylinders of cast iron 3/32-inch per foot.

Therefore, as an example, when an iron pipe casting is wanted, the pattern is made 12⅛ inches long and when the metal cools, the pipe or

casting will be 12 inches standard rule.

Steel shrink rules may be obtained as follows: 1/16, 1/12, 1/10, 3/32, ⅛, 5/32, 3/16, ¼, 5/16, ⅜, 7/16-inch shrink per foot. Most of these may be purchased with the four graduations namely 1/64, 1/32, 1/16, ⅛-inch marked on the edges and from 6 to 24 inches long. Some rules may be had with the shrink on one side and standard on the other but less mistakes will happen if the rule is marked with shrink on both sides. The shrink rules all are marked plainly with the amount of shrink in the rule as shown in Fig. 2.

The patternmaker, unless he has a pattern drawing with the shrinks allowed, lays out his work with the shrink rule. For example, when making a layout for a brass casting 6 inches long, he uses the 3/16 shrink rule and marks off 6 inches with that rule. If it were measured with the standard rule, it would measure 6 3/32 inches. It is obvious then that the shrink rule is subdivided so that each inch and fraction thereof are lengthened in proportion as one standard foot is to whatever shrink rule is used per foot. If a brass shrink rule measures 12 3/16 inches long, then each inch will be longer than the standard inch by 3/16 x 1/12 or 1/64. One-eighth inch to the foot equals 1/64-inch shrink in 1½ inches, 3/16-inch to the foot equals 1/64 shrink in 1 inch and ¼-inch to the foot equal 1/64-inch shrink in ¾-inch. Some patternmakers, when using a standard rule, add the shrink wanted. For instance, how many sixty-fourths should be added to 9 inches on the standard rule for cast iron shrinking ⅛-inch to 1 foot. In this case since the metal shrinks 1/64-inch in 1½ inches, divide 9 by 1½. This shows the metal will shrink 6/64-inch in 9 inches. With a brass shrink of 3/16-inch to 1 foot, the shrink would be 9 x 1/1 or 9. Therefore the metal would shrink 9/64-inch in 9 inches.

Measuring is accomplished in several ways, with either the standard or shrink rules. Usually in laying out work a knife is used to mark and draw the lines. In marking, the rule often is held inclined so that the line on the rule is as close to the layout board as possible, as shown in Fig. 3. The point of the knife marks the board. Often, the dividers or trammel points are set to measurement on the rule and then transferred to the layout board. Close and accurate measurements may be obtained with dividers. When one point of the dividers is placed in a division line on the rule, the other point is set out to the division line of the measurement wanted. Then by raising one point and then the other slightly, it may be noted whether both points are in the center and bottom of the groove of the division lines. It is far easier in most cases to feel a difference than it is to see it. Let us assume that we have a number and several fractions to measure with the dividers such as 3 3/32, 7/64 and 1/16-inches. We want to mark out the total without adding them up mentally or on paper. As illustrated at Fig. 4, one point of the dividers, shown at *A* is placed on one inch on the rule and the other point *B* passes over to 4 inches which makes the dividers opened 3 inches and then on to 3/32. The point *B* then remains stationary and point *A* is moved 7-64 inch toward the end of the rule as shown at *A*. The dividers then are lifted off the rule and point *A* is placed at the one inch mark and *B* will rest at the division line at 4 13/64. Then *A* is moved 1/16 toward the end of the rule as at *A'*. The total is then 3 plus 3/32 plus 7/64 plus 1/16-inches or 3 17/64 inches. With this method the total ot a large number of whole numbers and fractions may be determined easily. The method is limited only by the length of the rule.

It is understood that measurements required by the wood patternmaker are approximate. There is no intention of absolute correct measuring such as to thousandths of an inch. So when one uses a scale, the measurement of course is not absolutely correct but patternmakers measure closely at times.

Suppose we have a rule 12 inches long and wish to measure 13 inches. Usually the scale is laid down on the work and a knife cut is made at both ends of the rule, then the rule is moved forward until the 1 inch division line seems to coincide with the line marked with the knife and another knife mark is made at the end of the rule. When the rule is changed, there may be an error caused by failure to have the knife cut and the 1 inch division coincide correctly. Some overcome this trouble by using the rule and dividers. The dividers are opened to any size, for example, three inches. Then the rule is laid on the work, a knife cut made at one end and the dividers placed, one leg on the 10 inch division mark, and the other leg marking the wood one inch from the opposite end of the rule from that marked with the knife. This method makes the distance from the knife mark to the point in the wood 13 inches, as shown in Fig. 5. Many of these small details concerning easy methods for doing work do not seem important, but they really are a great help in not only measuring as closely as possible, but also in being expeditious. You have a job to do and there may be a dozen ways to do it. Always plan to do it in the quickest and best way. While it generally is a good plan to follow what some other fellow has been successful in doing, only copy that which is best. Try something new, as that is the way the world moves.

Faked Foundry Facts

A Runner

J. S. Barnes, board of education, Birmingham, England, in an address on apprentice training said that he believed that by means of a modest levy on the foundries of the Birmingham district, a fund sufficient to establish a model foundry for apprentice training, could be obtained.

International Nickel Co., New York, is having plans made for an addition to its plant at Port Colborne, Ont. The addition is designed to produce 600,000 pounds of electrolytic nickel per month. Other units will be added later to increase production considerably.

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
FRANK G. STEINEBACH, Associate Editor

¶ Iron Reflects Business State

WHILE all inclusive generalities may not be drawn, it may be stated with reasonable certainty, that when pig iron production is up, business in metal working lines is good. Upon this basis of comparison, the year 1925 will be remembered with favor. A report just issued by the American Iron & Steel institute, shows that the total of all grades of iron produced in the United States in 1925 amounted to 36,700,566 gross tons, compared with 31,405,790 tons during the preceding year. Only two peace-time years have exceeded 1925. These were 1920 with an output of 36,925,987 and the record breaking year of 1923 with its phenomenal make of 40,361,146 tons.

MALLEABLE pig iron showed a gain in 1925, the total tonnage of this grade reaching 1,553,636 gross tons, compared with the 1924 total of 973,-158. This increase of 59.65 per cent is difficult to reconcile with the decrease in foundry and ferrosilicon production and even with the relatively smaller increase of 16.86 per cent in the manufacture of all grades of pig iron. In 1925, the malleable grades represented 4.23 per cent of the combined blast furnace output, compared with 3.10 per cent in the previous year. In 1924 the merchant grades represented 26.8 per cent of the total, while this figure declined to 24.5 per cent in 1925.

FOUNDRY iron production does not make such a favorable showing. The total output of foundry iron and ferrosilicon, which are combined in the institute report, was 5,410,217 tons in 1925 and 5,623,124 tons the previous year. An interesting comparison may be made in computing the ratio of foundry iron to the total of all grades of pig iron, for a period of years. A tabulation showing the relationship of foundry grades to the total output, appears on page 315 of this issue of THE FOUNDRY. It will be noted that in 1924 the foundry iron constituted 17.9 per cent of the total, but in 1925, this ratio was 14.74 per cent. The total production of foundry iron and ferrosilicon decreased 3.79 per cent in 1925, compared with the previous annual total.

¶ They Do It Well Over There

LOCAL associations of American foundrymen in many instances might take a leaf with considerable advantage from the book of their British cousins in the manner in which they conduct their weekly, fortnightly or monthly meetings. On this side members consider they have done all that reasonably may be expected when they attend the meeting, partake of a good substantial dinner and listen to a paper or a more or less informal talk by the speaker of the evening. Occasionally a little desultory discussion takes place, but it is the exception rather than the rule. When the members at the request or suggestion of the chairman have tendered the speaker the usual rising vote of thanks and appreciation they are ready to call it a day and knock off. With characteristic American restlessness, once they are on their feet, they are in no mood to settle back again in their seats to discuss points of interest raised by the speaker.

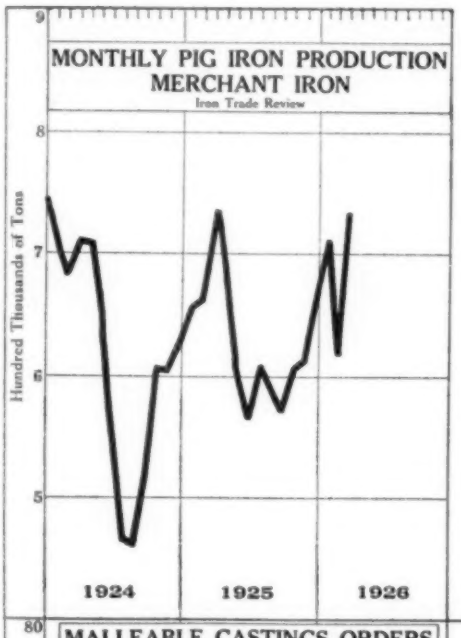
FROM a perusal of foreign foundry periodicals we gather that English and continental European foundrymen take their meetings more seriously. Invariably the presentation of a paper calls forth a spirited discussion. Almost without exception the members are master craftsmen who have served a regular apprenticeship in the art and science of founding in metals and while they do not question the sincerity of the author's views, still they have no hesitation in questioning his conclusions if these same conclusions do not coincide with their own on the same subject. The result is that the members hear a great many views instead of one and are at liberty to draw their own conclusions. Local conditions exert a powerful influence on many phases of foundry practice and the best method of solving a foundry problem in one locality might be totally unsuitable in another. Many men we are told, have many minds and in a multiplicity of counsel, there is wisdom.

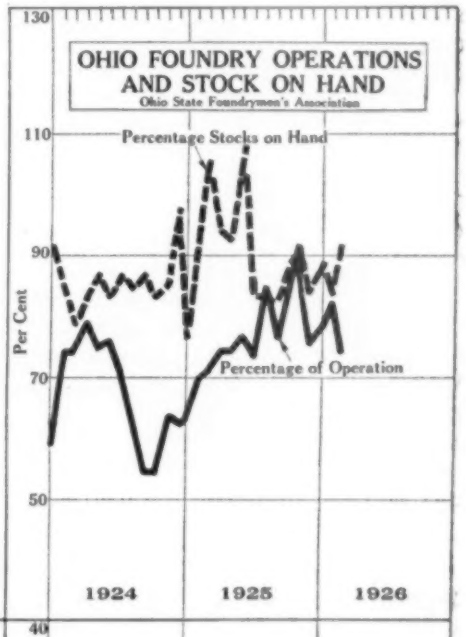
Trade Trends in Tabloid

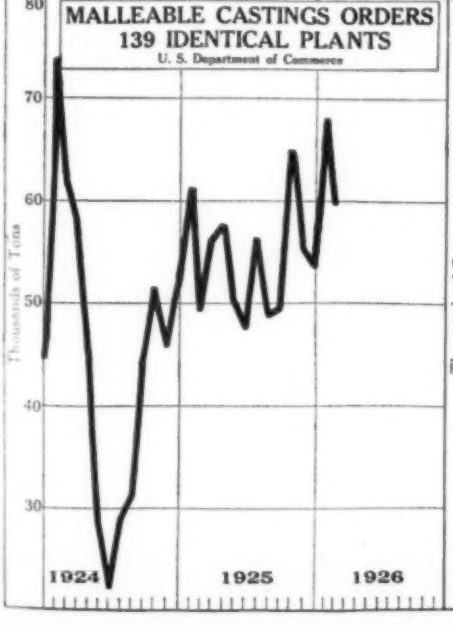
AUTOMOBILE manufacture continues to exhibit characteristics at varience with frequently stated prophesies. The total output of passenger cars and trucks for the United States and Canada for March, according to the National Automobile Chamber of Commerce was 447,185. This brings the production for the first quarter of the year to 1,138,409, the largest first quarter total for the past five years. The first three months figure is 18 per cent ahead of the first quarter of 1925. However, sales are reported slackening, while in certain centers manufacturers are storing surplus cars in warehouses. Pig iron prices have declined slightly, but production stood at a high figure in March, according to the *Iron Trade Review*. The total output of all classes of pig iron was 3,458,171 tons in March, compared with 2,923,850 tons in February. The daily average cast was 111,554 tons, compared with 104,423 tons in February. A total of 733,321 tons of merchant iron was made last month against 622,121 tons the preceding month with a net increase of three merchant stacks in blast. February building permits were 20 per cent ahead of the same month last year. Average New York prices of nonferrous metals for March follow: Casting copper, 13.483c; electrolytic copper, 14.123c; Straits tin, 64.565c; lead, 8.477c; antimony, 19.32c and zinc, 7.342c, St. Louis, Ill.

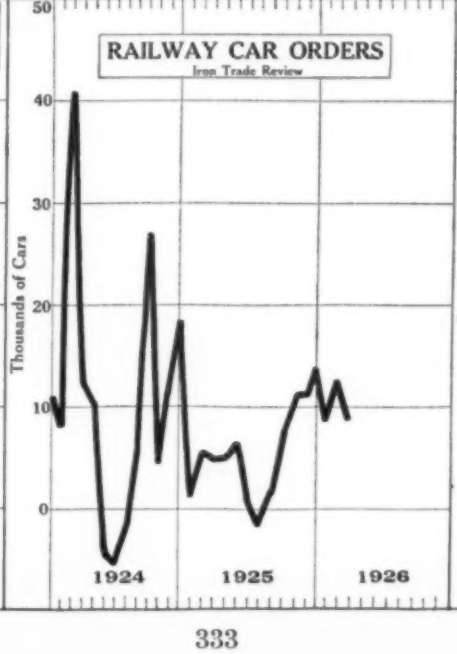
RAW MATERIAL PRICES
APRIL 7, 1926

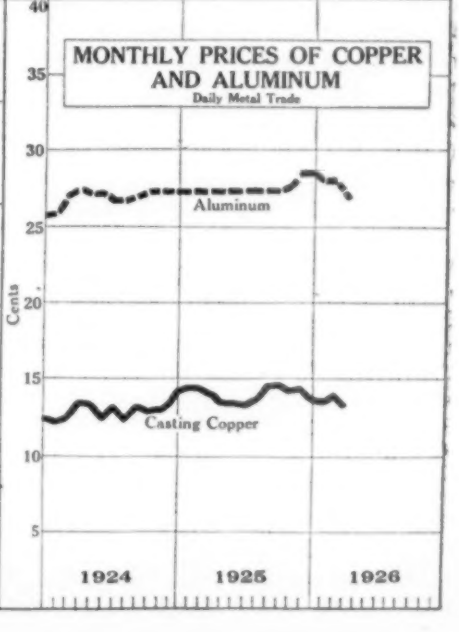
Iron	
No. 2 foundry, Valley	$19.00
No. 2 Southern Birmingham	23.00
No. 2 foundry, Chicago	23.00
No. 2 foundry, Philadelphia	23.26 to 23.89
No. 2 foundry, Buffalo	21.00
Basic, Valley	19.00
Basic, Buffalo	20.00 to 20.50
Malleable, Chicago	23.00
Malleable, Buffalo	21.00
Coke	
Connellsville foundry, coke	$4.00 to 4.75
Wise County foundry, coke	4.50 to 5.00
Scrap	
Heavy melting steel, Valley	$16.50 to 16.75
Heavy melting steel, Pitts	17.00 to 17.50
Heavy melting steel, Chicago	13.50 to 14.00
Stove plate, Chicago	15.75 to 16.00
No. 1 cast, New York	15.00 to 15.50
No. 1 cast, Chicago	18.75 to 19.25
No. 1 cast, Philadelphia	17.50 to 18.00
No. 1 cast, Pittsburgh	17.00 to 17.50
No. 1 cast, Birmingham	17.00 to 17.50
No. 1 cast, Buffalo	15.50 to 16.00
Car wheels, iron, Pittsburgh	17.00 to 17.50
Car wheels, iron, Chicago	16.75 to 17.25
Railroad malleable, Chicago	17.50 to 18.00
Agricultural, mall., Chicago	16.50 to 17.00
Malleable, Buffalo	19.50 to 20.00
Railroad Malleable Pitts	18.50 to 19.00
Nonferrous Metals	
	Cents per pound
Casting copper, refinery	13.40
Electro copper, producers	14.00
Straits Tin	63.75
Lead, New York	8.35
Antimony, New York	18.00
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	26.50
Aluminum, No. 12, remelt	24.50
Zinc, E. St. Louis, Ill.	7.15 to 7.20











Comings and Goings of Foundrymen

HORACE A. FROMMELT, formerly assistant works manager, Falk Corp., Milwaukee, recently has become associated with the International Correspondence schools, Scranton, Pa., as consultant in its apprentice training division. Since 1920 he has been connected with apprentice training in the shops of the Falk Corp., Mr. Frommelt was graduated from Campion college, Prairie du Chien, Wis., and received his master's degree in electrical engineering at Iowa State college, Ames, Iowa. During the past three years he has spoken and written a great deal on the subject of apprentice training. He has taken an active part in the development of the district plan of apprentice training that is in operation at Milwaukee. In this work he has been associated with Harold S. Falk, Falk Corp.; R. L. Cooley, director, Milwaukee vocational schools; L. S. Wiggins, Allis-Chalmers Mfg. Co.; and Steward Scrimshaw, Marquette university.

Harry W. Gilbert, in charge of the steel, iron, brass and aluminum foundries, Delaware & Hudson Co., Watervliet, N. Y., has resigned. He learned his trade in the Kerr-Murry Mfg. Co., Fort Wayne, Ind. starting in 1878. Mr. Gilbert has been connected with the St. Louis Car Wheel Co., St. Louis, John Featherstone Sons, Chicago, and also has had charge of the foundries of the New York Central railroad at Elkhart, Ind., and Frankfort, N. Y. from 1898 to 1909. For the present he will reside in Oak Park, Ill.

H. J. Young has resigned his position as chief chemist, North Eastern Marine Engineering Co. Ltd., Wallsend-on-Tyne, England and has opened an office at 3 Central buildings, Westminster, London, S.W.1 where he will practice as a consulting metallurgist. He has been retained by the previously mentioned firm and also by the British Perlit Iron Co. Ltd. Mr. Young is a member of the Institute of Metals and the Institute of British Foundrymen.

Burt Fleeger, treasurer, sales manager, and a director of Sivyer Steel Casting Co., Milwaukee, has resigned to become asociated with the Oklahoma Steel Castings Co., Tulsa, Okla., as vice president. Mr. Fleeger who has been with the Sivyer organization since 1913 has acquired a substantial interest in the Oklahoma firm and will be located in Tulsa.

H. R. Hire, secretary and manager, Crown Foundry Co., East Peoria, Ill., for the past four years, has become president and manager of the recently organized Hire Foundry Co., Averyville, Ill. Previous to his connections in Peoria, Mr. Hire was assistant foundry superintendent, Maytag Co., Newton, Iowa.

Is Accorded Public Recognition

DAVID McLAIN, foundry sage of Milwaukee and proprietor of McLain's System, Inc., which conducts correspondence courses in foundry practice is the subject of an article by William S. Dutton in the April issue of The American magazine. This interview recounts Mr. McLain's long and active service to the industry, his early struggles to obtain knowledge of elementary chemistry and the reasons for certain phenomena that he as a boy encountered in melting metals. Experiences, familiar through an article commemorating Mr. McLain's 50 years of foundry service, which appeared in THE FOUNDRY, *Feb. 15, 1923, are told in an entertaining manner by Mr. Dutton.*

John W. Taylor now is connected with the Ferro Machine & Foundry Co., Cleveland in the experimental department. Mr. Taylor received his foundry training in England, and was foundry foreman at Pickup & Kelley, Darwen, Lancashire for four years. Later he removed to Canada and then to the United States where he was in charge of the foundry of McLouth Industries Inc., Marine City, Mich. For the past three years Mr. Taylor has been machine demonstrator for the E. J. Woodison Co., Detroit.

R. J. Young, formerly in charge of the electric steel section, Philadelphia navy yard, has been appointed production manager of the Messinger Mfg. Co., Tatamy, Pa., manufacturer of agricultural equipment and general jobbing foundry. He was educated at Lehigh university, Bethlehem, Pa., and has been connected with Taylor-Wharton Iron & Steel Co., High Bridge, N. J. and Bethlehem Steel Co., Bethlehem, Pa.

Albert S. Braughton, superintendent, A. L. Swett Iron Works, Medina, N. Y., recently was honored in recognition of the completion of 50 years of service by a dinner given by the firm. At the age of 13 he began his career with the company, then the Medina Mfg. Co., as an errand boy. During this period he learned coremaking and made himself useful around the foundry. He continued his work for several years and due to his ability to handle men, he was placed in charge of the foundry at the age of 20. Mr. Braughton held this position for 13 years. He then was made superintendent of the entire plant, which position he still holds. About 90 fellow employes attended the dinner, and presented him with a pair of field glasses as a tribute to his long service with the firm.

Institute of Metals Holds Annual Meeting

At the annual meeting of the Institute of Metals held in London, England on March 10 to 11, Sir John Dewrance, Dewrance & Co., London, was elected president. Three vacancies for vice presidents were filled by Sir Robert B. Dixon, vice admiral, Sir Thomas Kirke Rose, Royal mint, and W. Murray Morrison, British Aluminum Co. The council reported that the present membership of the institute is 1747, and that a large number of foreign members have joined.

Fifteen papers were submitted at the technical sessions. The first was presented by George Mortimer, William Mills Ltd., Atlas Works, Birmingham, on the die-casting of aluminum alloys. The five current methods of die-casting were reviewed, and pressure casting and gravity casting were selected for closer consideration. He pointed out that although pressure castings may be thinner, more accurate, better finished and produced at a greater rate, they are not as sound or as reliable as castings poured by gravity. The gravity mold is cheaper in first cost

and upkeep charges and present requirements of the industry in Great Britain are best met by the more flexible gravity process. This process was described in detail.

In the discussion of this paper Dr. Walter Rosenhain said that to obtain the correct figure of crystallization shrinkage, the density of the final metal should be considered. He stated that sometimes castings are obtained which present cavities and in other cases general porosity. He stressed the fact that the rate of inflow of metal and the rate of solidification have much to do with the soundness of the casting.

Conducts Conference on Electric Heating

What is believed to be the first industrial electric heating conference ever sponsored by an engineering school, recently was conducted by the engineering extension department of Purdue university, Lafayette, Ind. More than 150 representatives from many industries in Indiana and the district surrounding Chicago attended the meeting.

The program covered the entire field of electric heating and included papers and demonstrations of equipment ranging from low temperature, automatically-controlled baking ovens to the high temperature arc furnace for melting brass and steel. The principal speakers at the banquet were David E. Ross, Ross Gear & Tool Co., Lafayette, Ind., and J. L. Bray, Purdue university. Among the companies that exhibited and operated equipment at the conference were: General Electric Co., Schenectady, N. Y.; Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; Detroit Electric Furnace Co., Detroit; Pittsburgh Electric Furnace Corp., Pittsburgh; Young Bros. Co., Detroit; Bristol Co., Waterbury, Conn.; Leeds & Northrup Co., Philadelphia; and Taylor Instrument Co., Rochester, N. Y.

Lee & Clark Inc., Chicago, has been incorporated to take over the business conducted under the name of the James T. Lee Co. James T. Lee, president, was formerly with the Hanna Engineering Co., and for the past five years was western manager of Southwark Foundry & Machine Co. John O. Clark, vice president, for a number of years was sales manger of the Hanna Engineering works. The firm specializes in hydraulic equipment, pumps, car wheel borers, metal working machinery, etc.

Obituary

Daniel M. Brady, whose death was announced in a recent issue THE FOUNDRY, was born in New York City May 6, 1854. He entered the service of the New York Central railroad in 1871. Nine years later he founded the Brady Brass Co., which he controlled at the time of his death. Mr. Brady was a brother of the famous "Diamond Jim" Brady. He maintained his affiliation with the railroad business and at the time of his death was a member of Metropolitan chapter, New York Central Veterans association.

Randolph E. Rubner formerly president of the Urick Foundry Co., a subsidiary of the Erie Malleable Iron Co., Erie, Pa., died recently from injuries sustained when thrown from a horse. He entered the employ of the Erie Malleable Co., as a boy in 1903 and retained association with it until his death.

John J. Meehan, vice president of the former James A. Brady Foundry Co., Chicago, died recently at the age of 65 years. Several years ago when superintendent of the Brady foundry, he lost his eyesight through an explosion of a mold during the pouring. This injury was believed would result in his incapacitation and he was given a position of telephone operator, but due to his retentive memory, he became invaluable to the president of the company, and the direction of the foundry was placed in his hands.

William J. Johnson, superintendent of foundries, Baldwin Locomotive Works, Philadelphia, died recently at his home in Ridley Park, Pa., during a severe attack of coughing.

Emmett J. Bondurant, 57, president, Georgia Plow & Foundry Co., Athens, Ga., died recently, following a brief illness. Mr. Bondurant was born in Augusta, Ga., 1869, and in 1888 graduated from the University of Georgia. He remained in Athens and built up the Plow & Foundry company, and was a former trustee of the University of Georgia and of the State Normal Training school, Athens.

W. W. Shilling, president, Sharon Foundry Co., Sharon, Pa., died Sunday, March 21, at the age of 69. Mr. Shilling was born Oct. 24, 1856, at Wheatland, Pa., and obtained his education at the Edinboro Normal school, Edinboro, Pa., Eastman college, Poughkeepsie, N. Y., and Allegheny college, Meadville, Pa. Admitted to the Pennsylvania state bar in 1882, he practiced law in Sharon, Pa., for eight years before being elected president of the Sharon Foundry Co. in 1905, with this interest he was actively engaged until his death, giving over his legal practice 30 years ago.

Foundry Association Directory

The Buffalo Foundrymen
Buffalo

President, J. McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, CHARLES L. LARSEN, Armour Institute of Technology 3200 Federal street, Chicago; secretary-treasurer, E. C. BARRINGER, THE FOUNDRY, 1147 Peoples Gas building, Chicago. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry, Co., 131 South Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Foundry Association
New York

President, THOMAS HARPER, Thomas Harper, 204 Lafayette street, New York; secretary, WM. E. PAULSON, Thomas Paulson & Son, Inc., 97 Second avenue, Brooklyn, N. Y. Meetings second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meetings called by president.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, CHARLES R. SPARE, Janney Cylinder Co., Holmesburg, Phidadelphia; secretary, HOWARD EVANS, J. W. Paxson Co., Luzerne and D street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, WILLIAM K. FRANK, Damascus Bronze Co., South avenue, N. S. Pittsburgh; secretary-treasurer, WM. J. BRANDT, Wm. J. Brandt, Bessemer building, Pittsburgh. Meetings on the third Monday of the month, except in July and August, at the Fort Pitt hotel.

Quad-City Foundrymen's Association
East Moline, Ill.

President, P. T. BANCROFT, John Deere Harvester Works, East Moline, Ill.; secretary-treasurer, D. H. WARD, Union Malleable Iron Co., East Moline. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island, and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, W. C. TROUT, Lufkin, Tex.; secretary-treasurer, W. E. DUNN JR., Healey building, Atlanta, Ga. The 1926 convention to be held at Macon, Ga., the date to be announced later.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, J. A. TEACH, Minneapolis Steel & Machinery Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, So., Minneapolis. Meetings monthly at the Athletic club.

Equipment Sales Slackening

With Exception of Cleveland Territory, Various Distributing Centers Find Sales Falling Slightly from Volume in March —Exports Decline in February

THE slight decrease in sales of foundry equipment noted several weeks ago, is continuing in practically all distributing centers. The one exception is in the Cleveland territory, where the momentum gained by the market during the record month of March is continuing into April. Manufacturers feel that sales soon will increase. This optimistic tendency is caused by the satisfactory number of inquiries being brought out, and by the high operating capacity which is being maintained by many foundries. Several new construction projects are contemplated and a number of new plants or plant extensions are under construction. Among the latter may be included the new foundry of the Southern Wheel Co. at St. Louis and the plant of the McWane Cast Iron Pipe Co., Birmingham, Ala.

Sales of foundry equipment in February gained 14 per cent over the sales in January and 38 per cent over February last year, according to a report of the Foundry Equipment Manufacturers association. The sales in February totaled $472,814 as compared with $414,121 in January and $340,826 in February, 1925. Shipments for the month were valued at $422,004 as compared with $445,377 in January and $279,049 in the corresponding month a year ago. The gain in shipments in February over the same month in 1925 was 51 per cent. Orders on hand March 1 were $536,978 as compared with $501,793 on Feb. 1 and $446,895 on March 1, 1925. Orders on hand on March 1 were 20 per cent greater than at the same date a year ago.

Exports of foundry and molding equipment in February showed a marked decline, according to a report of the department of commerce. The value of exports in February was $27,083 as compared with $42,695 in January and $42,096 during February, 1925. The value of exports for the eight months ended February was $404,591 as compared with $390,510 during the corresponding period a year ago. Carlo Merkel, Corso Inglilterra 31, Torino, Italy, wishes to obtain catalogs of American foundry equipment.

Volume of Inquiries Continues Heavy

FOUNDRY equipment demand in the New York metropolitan district continues sluggish. Sellers assert that spring buying so far is not up to the volume of last year and is substantially less than two years ago. Jobbing foundries appear more active; and railroad activity, on which much faith has been placed in some quarters, is developing in fairly satisfactory manner insofar as locomotives are concerned. This situation soon may be reflected in heavier equipment buying. Shakeout bails have been sold to the Southern Wheel Co., Rochester, N. Y. and vibrator and shakeout equipment to A. Weiskittle & Son Co., Baltimore, and the U. S. Radiator Corp., Geneva, N. Y., by the Stoney Foundry Engineering & Equipment Co., Cleveland. The W. W. Sly Mfg. Co., Cleveland, has sold dust arrester equipment to the Eddy Valve Co., Waterford, N. Y., and two large tumbling mills to the Elmira Foundry Co., Elmira, N. Y. Sandblast equipment has been purchased by the Norfolk & Western Railway Co., Roanoke, Va., the Baltimore & Ohio Railway Co., Baltimore, and the Thatcher Furnace Co., Newark, N. J., and sandblast and dust arrester equipment to the De Lavel Steam Turbine Co., Trenton, N. J., by the Pangborn Corp., Hagerstown, Md. New building construction at present is limited. The United States Cast Iron Pipe & Foundry Co., Burlington, N. J., has awarded contract for an addition to its Scottsdale, Pa., plant, but it is understood that the extension will be a forge and blacksmith shop.

Less Inquiries In West

CHICAGO district makers of foundry equipment have experienced a letdown in inquiry, but business that has been pending reveals not a great deal more sales resistance. Sales of the National Engineering Co., Chicago, include sand mixers to the Lynn, Mass., and Schenectady, N. Y., works of the General Electric Co. and the Chrobaltic Tool Co., Michigan City, Ind. Sandblast equipment has been secured by the Buick Motor Co., Flint, Mich. and the Wagner Malleable Iron Co., Decatur, Ill., and sandblast and dust arrester equipment has been purchased by the South Side Malleable Casting Co., Milwaukee, from the Pangborn Corp., Hagerstown, Md. The American Foundry Equipment Co., Mishawaka, Ind., has sold sand cutting machines to the Great Lakes Foundry Co., Port Huron, Mich., the Flint Malleable Castings Co., Flint, Mich., the Eureka Stove Co., O'Fallon, Ill., the Central Foundry Co., Marshalltown, Iowa, the Waukesha Foundry Co., Waukesha, Wis., and the Jenkins Machine Co., Sheboygan Falls, Wis., and sandblast and dust arrester equipment to the Union Sanitary Co., Noblesville, Ind., and the Ingersoll-Rand Co., Sherbrooke, Que. The American Car & Foundry Co., Madison, Ill., has purchased shakeout bails and the Standard Foundry Co., Racine, Wis., the Holmes Foundry Co., Port Huron, Mich., the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., and the Columbia Sanitary Mfg. Co., Louisville, Ky., has secured vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland. The W. W. Sly Mfg. Co., Cleveland, has sold a sandblast room, turntable and dust arrester equipment to the Holmes Foundry Co., Port Huron, Mich., two sandblast rooms with dust arrester equipment and pressure tanks to the Campbell, Wyant & Cannon Foundry Co., Muskegon, a sandblast cabinet to the Auburn Foundry Co., Auburn, Ind., and a sandblast mill to the Blackhawk

Foundry & Machine Co., Davenport, Iowa. The Semisteel Test Foundry Co., Chicago, has secured a sand mixing machine from the Standard Sand & Machine Co., Cleveland.

Cleveland Sales Continue

A NUMBER of manufacturers of foundry equipment in the Cleveland territory report that sales in March were greater than in any month during the past year. The business for the first week in April was heavy and builders feel that business in the present month will equal the total for March. Inquiries are heavy for practically all lines of equipment, including core ovens, sand mixing and handling equipment, molding machines and cleaning room equipment. The Westinghouse Electric & Mfg. Co., Cleveland, has purchased a sand separator and blender built by the Royer Foundry & Machine Co., Wilkes-Barre, Pa. The American Foundry Equipment Co., Mishawaka, Ind., has sold two sand cutting machines to the Dayton Malleable Iron Co., Dayton, O., two to the Walworth Alabama Co., Attala, Ala., and sandblast and dust arrester equipment to the United States Aluminum Co., Cleveland. The W. W. Sly Mfg. Co., Cleveland, has sold a tumbling mill to the West Park Foundry Co., Cleveland, six large mills to the Superior Foundry Co., Cleveland, two large tumbling mills and dust arrester equipment to the Ohio Malleable Iron Co., Columbus, O., dust arrester equipment to the Gartland-Haswell-Rentschler Co., Dayton, O., a sandblast mill to the Champion Hardware Co., Geneva, O., and a large sandblast mill to the Detroit Stove Works, Detroit. Kuhns Bros., Dayton, O., has purchased two tumbling mills in addition to the six reported in the April 1 issue, this business going to the Sly company. Sandblast equipment has been purchased by the International Harvester Co., Springfield, O., and by the Detroit Gray Iron Foundry Co., Detroit, from the Pangborn Corp., Hagerstown, Md. The Salem Electric Furnace Co., Salem, O., is building two large annealing furnaces for Dodge Bros., Detroit. The General Electric Co., Erie, has purchased a 2-ton crane from the Niles Crane Corp., New York. Shakeout bails have been purchased by the American Radiator Co., Buffalo, the U. S. Aluminum Co., Cleveland, the Fremont Foundry Co., Fremont, O., and vibrator and shakeout equipment by the Dayton Steel Foundry Co., Dayton, O., from the Stoney Foundry Engineering & Equipment Co., Cleveland. That manufacturer is building two molding machines with a vibrator ram top and bottom. These machines will be used in the manufacture of automobile cylinders by the Ferro Foundry & Machine Co., Cleveland. Alfred T. Wagner, Detroit, has purchased a sand mixing machine from the Standard Sand & Machine Co., Cleveland.

New England Buying Lags

THE rate of melt among New England foundries holds up fairly well but equipment buying during the past ten days has subsided. March sales were ahead of either January or February. The equipment market in Connecticut is more active than in the other states. The Connecticut Foundry Co., Rocky Hill, Conn., has purchased molding machines and also has taken three pouring units from the Modern Pouring Device Co., Port Washington, Wis. The Glenwood Range Co., Taunton, Mass., has secured dust arrester equipment from the W. W. Sly Mfg. Co., while the Florence Stove Works, Gardner, Mass., has purchased a tumbling mill from the same manufacturer. The Millbury Steel Foundry, Co., Millbury, Mass., has placed an order for coreroom equipment with the J. W. Paxson Co., Philadelphia.

Pittsburgh Orders Slacken

ONLY a fair number of orders have been placed recently for foundry equipment in the Pittsburgh area. However, a vast number of inquiries are pending and prospects for good business in the late spring and summer are brighter than ever. Large molding machine sales have supplied one of the market's features in this district, as noted by the Herman Pneumatic Machine Co., Zelienople, Pa. That company transacted more business during the first three months of this year, than it did in the first five months of 1925. On April 1 it had a large amount of business pending, and numerous verbal contracts for complete installations for new plants. One in the south and one in the middlewest, await confirmation. Typical orders recently booked include large rollover units from the American Radiator Co., Buffalo, and the American Car & Foundry Co., New York. The American Locomotive Co. New York bought two 8 x 10-foot rollover machines from this interest for its steel foundry at Chester, Pa. One or two local malleable iron manufacturers bought electric furnaces recently. Several foundries in territory adjacent to Pittsburgh are in the market for blower equipment. The Sheldon Axle & Spring Co., Wilkes-Barre, Pa., has purchased sandblast equipment from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Otis Elevator Co., Eleventh avenue and Twenty-sixth street, Harrison, N. J., will build an extension to its car shop, one story 80 x 100 feet. General contract to James Stewart & Co., Inc., 17 East Forty-second street, New York.

Western Reserve Foundry Co., Cleveland, F. T. Chyall president, is considering a 2-story plant to be erected in about a year.

Parkersburg Rigg & Reel Co., Parkersburg, W. Va., is taking figures on a considerable addition to its plant here.

Malleable Iron Range Co., Beaver Dam, Wis., H. T. Burrow president, 715 North Spring street has let general contract to Hutter Construction Co., for a 2-story addition 100 x 110 feet.

National Foundry Co., Sixteenth and Raspberry streets, Erie, Pa., will build a brick addition 40 x 60 feet to its plant.

Wellsville Foundry Corp., Wellsville, N. Y., has been incorporated to operate a foundry with $20,000 capital by Charles M. Fedderman, 627 Magie avenue, Elizabeth, N. J.; O. Delford Fedderman, 178 Saranac avenue, New York, and J. Albert McEachern, Wellsville. Lee Fassett, Wellsville, is attorney.

Novelty Mfg. Co., Milford, Mass., has been incorporated with $15,000 capital to operate a general foundry and machine shop business, manufacturing machinery, pumps, winches, capstans, tools, by Joseph Albiuso president, Rudolph Mainini treasurer and Enrico Iacovelli clerk.

Monarch Machine & Mfg. Co., Greensboro, N. C., has been incorporated with $100,000 capital by C. H. Lewis, A. R. Lewis and E. J. Lewis and has bought the plant and machinery of the Westbrook Elevator Co., 531 South Eugene street. Cook-Lewis Foundry Co., is large stockholder in the new company.

Standard Stove & Range Co., Rome Ga., has been incorporated with $8000 capital and will build a foundry on the Alabama road.

National Aluminum Mfg. Co., 107 Main street, Peoria, Ill., has been incorporated

with $25,000 capital to manufacture brass, aluminum and metal cooking utensils and casting by Joseph M. Liebig, Leo F. Cavanaugh and John F. Kelley. Weil, Bartley & Weil, 907 Jefferson building, are correspondents.

Tennent Steel Casting Co., Tacoma, Wash., is having plans made for a 1-story foundry plant.

Piston Ring Co., 500 Sanford street, Muskegon, Mich., will build a 4-story addition 120 x 125 feet. C. E. Johnson is president.

Enterprise Bronze Co., Pittsburgh, has leased a building at 515 Reedsdale street and will equip it as a foundry for production of nonferrous castings. (Noted Jan. 15).

Gulf Coast Machinery & Supply Co., 305 Orange street, Port Arthur, Tex., R. M. Tryon manager, will build a 1-story brass foundry and machine shop.

Aluminum Foundry & Mfg. Co., Chattanooga, Tenn., has been incorporated with $100,000 capital by J. V. Trotter, 704 Cherry street, and others.

Nadler Foundry & Machine Co. Inc., Plaquemine, La., has been incorporated with $100,000 capital by Carl S. Nadler president and Joseph Allen secretary.

Bloomfield Pattern Works, 497 Bloomfield avenue, Bloomfield, N. J., has been incorporated and will enlarge its plant during this year. (Noted March 15).

Gurney Heater Mfg. Co., 96 Arlington street, Framingham, Mass., will build an addition and a craneway, from plans by Lockwood, Greene & Co., 24 Federal street, Boston.

Lock Joint Pipe Co., Ampere, N. J., has obtained a site in the Clearing industrial district at Chicago and will build a plant for production of its regular line of water and sewer pipe.

Blackhawk Foundry & Machine Co., Davenport, Iowa., has awarded a contract to Owens & Bivens for construction of an addition 70 x 90 feet, two stories, to double its capacity. (Noted March 1).

Anderson Stove Works, North Anderson, Ind., J. C. Quinn general manager, will take bids soon on an addition to its plant from plans by E. F. Miller, architect, Farmers Trust building. (Noted April 1).

Waterloo Gasoline Engine Co., Waterloo, Iowa, has changed its name to John Deere Tractor Co., effective April 1. There is no change in ownership, management or officers.

McWayne Cast Iron Pipe Co., Birmingham, Ala., manufacturer of pressure pipe, is building an addition to its foundry, covering 8800 square feet. Nashville Bridge Co., is erecting the building.

Lily Foundry Co., Los Angeles, Calif., has started operations in its new plant at East Twenty-sixth street and Indiana avenue, and has tentative plans in hand for an extension to increase capacity. (Noted Dec. 15).

Hire Foundry Co., Averyville, Ill., which recently was incorporated has leased the foundry of the Avery Power Machinery Co. The Hire company will make gray iron, semisteel and, nickel-chromium castings. About 75 men will be employed. (Noted April 1)

Leary Manley Co., Alabama and Spring Grove streets, has changed its name to Queen City Foundry Co., and has become incorporated. J. D. Leary is president. The former business will be continued without change.

Hi-Test Bronze Die Casting Co., 326 West Madison street, Chicago, has been incorporated with $100,000 capital to manufacture castings and specialties by Oscar Wahlgren, W. A. Murphy, Duane Reed, Reginald C. Darlet, 64 West Randolph street, is correspondent.

Standard Brass & Mfg. Co., Port Arthur, Tex., H. J. LeBlanc manager, has let contract to Truscon Steel Co., Youngstown, O., for 50 x 110-foot plant and will install melting furnaces, core ovens, trolley system, molding machines, sand blast and complete machine shop equipment.

Pekin Foundry & Mfg. Co., Pekin, Ill., recently incorporated, has purchased the assets of the Duisdieker Foundry & Mfg. Co. The company is capitalized at $10,000, and manufacturers retorts, heavy and light gray iron, semisteel and ferronickel castings. A. V. Martens is president and general manager.

Wood Bros. Thresher Co., Des Moines, Iowa, is receiving bids on a new plant, which will cover 430 x 500 feet, sawtooth and monitor construction. The plant will contain gray iron foundry, machine shop, forge shop, steel fabricating department, sheet metal shop, woodworking and general assembly departments. (Noted Feb. 1).

General Foundry Products Corp., Coxsackie, N. Y., recently incorporated, was formed for the purpose of buying the foundry and machine shop plant owned by J. G. Newbury. The new company is composed of interests connected with the Coxsackie Holding Corp., manufacturer of projection apparatus. (Noted March 15).

The Mason Machine Works, Taunton, Mass., manufacturers of textile machinery, will be sold shortly to a syndicate of Chicago business men, according to Albert R. White of the Mason Machine Works. The plans for the future operation of the plant as well as the names of the purchasers are withheld.

Loeffelholz Co., Milwaukee, will start work at once on its new brass foundry to be erected on Oregon street. The first building to be constructed will be 50 x 140 feet and 30 feet high, costing about $75,000. A second building of approximately the same size will be built later to replace the present buildings on the site. H. C. Haeuser, Colby-Abbot building, Milwaukee, is architect. George B. Miller is manager of the firm.

New Trade Publications

FLUXES—A folder issued by the Basic Mineral Co., Pittsburgh, gives the claims of the fluxes manufactured by this firm.

CUTTER AND TOOL GRINDER—Gallmeyer & Livingston Co., Grand Rapids, Mich., has issued a bulletin describing its universal cutter and tool grinder, as redesigned for self-contained motor drive.

REFRACTORIES—Fire brick designed to resist the destructive effects of various factors of service are featured in a leaflet by the Ashland Fire Brick Co., Ashland, Ky.

BELTING—Belts and accessories are featured in a bulletin by the Akron Belting Co., Akron, O., giving various grades for varied uses. It is illustrated by representations of fastenings, clamps and attachments.

POWER DRIVE—A self-contained unit, portable and capable of being connected with various tools, and containing a motor and chuck, is described and illustrated in a bulletin by the Borden Co., Warren, O.

HEAT TREATMENT—International Nickel Co., New York, has published a 10-page bulletin on the heattreatment and applications of nickel and nickel-chromium steels. This is the third of a series on nickel steel.

STOKERS—Detroit Stoker Co., Detroit, has issued a 24-page bulletin on its underfeed stokers, with illustrations covering its features, as well as the method of controlling movement of the fuel during the entire process of combustion.

SURFACE GRINDERS—Bulletins giving details of construction and operation of 14-inch and 22-inch vertical surface grinders are being sent out by the Pratt & Whitney Co., Hartford, Conn. The machines are of new design and contains a number of radical changes.

ELEVATORS—Two bulletins by the Revolvator Co., Jersey City, N. J., are the first of a series designed to cover the entire line of elevators, lifters, stackers, piling and tiering machine revolving, nonrevolving, open end and stationary, and other products of the company.

DRY GRINDING—A bulletin by the Ransom Mfg. Co., Oshkosh, Wis., describes its motor driven dry grinding machines, ball bearing, and equipped with speed controller. It is possible with this equipment to maintain a constant peripheral speed until the wheel is worn to the flanges.

TWIST DRILL GRINDER—Keystone Grinder & Mfg. Co., Pittsburgh, has issued a bulletin describing its motor driven grinder for redressing twist drills. It is devised so that perfect results may be obtained by inexperienced operators. Various features are given detailed description.

OVEN FURNACE—Accomplishment of carbonizing, hardening and annealing without a forced air blast is deseribed in a bulletin by the Johnson Gas Appliance Co., Cedar Rapids, Iowa, describing its oven furnace. A new size has been put on the market with features that simplify its use.

ELECTRIC DRILLS AND REAMERS—Hisey-Wolf Machine Co., Cincinnati, has issued a catalog showing its line of portable electric tools, including drills, reamers, screw drivers, radial drills, drilling stands, grinding and buffing machines with full information as to sizes and capacity.

PULVERIZED FUEL BURNERS—Combustion Engineering Corp., New York, in a catalog just issued, describes its unit system for installation in small plants. In this system coal is pulverized and fed directly to the furnace instead of being stored and drawn on as needed. The catalog covers all features of such installations.

HANDLING EQUIPMENT—A catalog of standard filing size, with reference tables attached, featuring the trucks and tiering machines manufactured by the Lewis-Shepard Co., Boston, is an attractive current publication. It is amply illustrated to show details of construction and varied uses of the several pieces of apparatus.

HEAT TREATMENT—Use of the dilatometer in heat treatment of steel is described in detail in a bulletin by the Stanley P. Rockwell Co., Hartford, Conn. The theory of this instrument in determining the changes taking place in steel under heat is explained fully, with its application to practice in obtaining certain results in the crystalline structure of the metal.